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CONTENTS

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EDITORIAL

This issue of the Date Palm Journal contains 10 research papers, a short communication, and a section on documentation.

As a follow up to their paper in the preceding issue of the Date Palm Journal, Sawaya and co-workers present data on the tannin, sugar and vitamin contents of 55 date cultivars grown in Saudi Arabia. The information is of relevance to taste, palatability, consistency and nutritive value of dates. Analyses done at Khalal and Tamar stages disclose the changes occurring in the different constituents as ripening proceeds. Ripe dates stand out as a rich source of sugar but are poor in vitamins A and C.

Jarrah presents an account of the changes in dimensions and constituents that occur during the developmental stages of fruits of the cultivar Khadrawy.

The moisture content of harvested dates has an important bearing on handling, storage and subsequent utilization. Cultivars are known to vary in this respect and broad classification into Dry, Semi-Dry and Soft types depend on moisture and the degree of sugar inversion. Shukur discusses some theoretical and practical implications of techniques used in moisture determinations and proposes a modification of the standard AOAC method for sugary fruits. Drying minced samples at 70°C for 6 hours at a pressure of less than 50mm mercury is suggested.

Nezam El-din and co-authors present analyses of soluble and condensed tannins in fronds, spathes and fibrous leaf bases of the cultivar Zahidi. The interest in these compounds stems from their influence on taste and digestibility of fruits, possible role in affording protection against pest and disease attack and the potential extraction of tannins for industrial use.

Bukhaev et al examine the pollen and floral parts fof five male Iraqi cultivars for their contents of some lipid fractions and other compounds. The main justification for this research was a preliminary observation that

some lipid fractions obtained from date pollen appeared to attract certain insects. Studies on different cultivars might also furnish biochemical bases for their identification.

Tissue Culture of date palms has for some time, attracted considerable attention as a convenient means of mass multiplication of desirable varieties. Propagation by offshoots is cumbersome, slow and expensive. Zaid and Tisserat report on their work for achieving differentiation *in vitro* of explants of shoot tips and apical meristems of Deglet Noor seedlings. Culture methods and media are described in their illustrated paper.

Khairi et al. report on their work on fruit thinning of Khastawi dates in Central Iraq.

Ephestia cautella is an important pest of stored dates in Iraq and various methods are employed for sterilization which will not cause changes in the quality or result in any health hazard to consumers. Al Azzawi and co-workers present results obtained when elevated temperatures combined with reduced atmospheric pressures and regulated humidity are employed on dates with different developmental stages of the pest. Al Hakkak et al present a further contribution in their series of papers on the use of high doses of gamma-radiation for the same purpose.

Al-Hassan and Abbas present their investigation of the biology of the fungus *Thielaviopsis paradoxa* which is an important causal agent of fruit rot on dates while still on the tree. Culture methods and the sensitivity of the mycelia to several commercial fungicides are described.

In a short communication, Ba-Angood and Ahmad describe a condition causing partial yellowing of date fronds in the UAE. While excluding fungi, bacteria, viruses or mycoplasma as the causal agent, they suggest that an imbalance of inorganic nutrients may be responsible.

Johnson lists eleven Masters and PhD theses dealing with subjects relating to date palm and other species of *Phoenix*. Mohan (of the Regional Project) presents abstracts of 21 recently published papers on date palm and related subjects.

The Regional Project endeavours to provide through the "Date Palm

Journal", information and views that could assist in further developing and strengthening the date industry and improving the returns to farmers, handlers and processors of date palm products.

The Editorial Board welcomes from readers any suggestions for further improving the technical standard, presentation and usefulness of the Journal.

M.M.A. Khairi
Chairman, Editorial Board

NOTES FOR AUTHORS

The Date Palm Journal is published twice a year by the FAO Regional Project for Palm & Dates Research Centre (NENADATES), Baghdad, Iraq. Contributions to the Journal may be (a) papers of original research in any branch of date palms, (b) review articles, (c) short communications, and (d) news and views. The research papers submitted for publication in the Journal should not have been previously published or scheduled for publication in any other journal.

Manuscripts

Papers may either be in Arabic or in English with summaries in both. The manuscript should be typewritten (double spaced, with ample margins) on one side of the paper only. Two copies of the manuscript should be submitted, the original typed copy along with a carbon copy. Authors should organize their papers according to the following scheme as closely as possible: (a) title of paper, (b) author's name (and affiliation written at the bottom of the first page), (c) abstract, (d) introduction, (e) materials and methods, (f) results, (g) discussion, (h) conclusion, (i) acknowledgement (s), (j) literature cited (arranged alphabetically), using the following illustrated format:

Andlaw, R.J. (1977): Diet and dental caries – a review. J. Human Nutrition 31:45.

Francis, D.E.M. (1974): Diet for sick children, 3rd Ed. Oxford: Blackwell. 405 pp.

Lepesme, P. (1947): Les insects des palmiers. Paris: Lechevalier. 247-48.

Tahara, A.; T. Nakata & Y. Ohtsuka (1971): New type of compound with strong sweetness. Nature 233:619.

However, in case of short papers and communications, results and discussion could be combined in one section.

Tables

Tables should be reduced to the simplest form and should not be used where text or illustrations give the same information. They should be typed on separate sheets at the end of the text and must in no case be of a size or

form that will not conveniently fit onto the Journal page size. Units of measurement should always be clearly stated in the column headings; any dates relevant to the tabulated information should be stated in the table title or in the appropriate column heading.

Illustrations

Line drawings and graphs must be in jet black ink, preferably on bristol board or tracing paper .Photographs should be on glossy paper, negatives being supplied where possible. Figures including both line drawings and photographs, should be numbered consecutively in the order in which they are cited in the text. The approximate position of tables and figures should be indicated in the manuscript.

Units

Units should follow the metric system. Yield or rate is expressed in metric tons/hectare or kg/hectare. Any reference to currency should be expressed in U.S. dollars or the equivalent to a local currency stated in a footnote.

Offprints

Unbound, free copies of offprints are allowed as follows: one author, 20 copies: two or more authors, 30 copies. Additional copies may be obtained on payment at cost and if more than the gratis number is required, this should be specified when the paper is submitted.

Correspondence

Contributions and correspondence should be addressed to the chairman, Editorial Board, Date Palm Journal, c/o Regional Project for Palm & Dates Research Centre in the Near East & North Africa, FAO, P.O. Box **10085, Karradah Al-Sharkiyah, Baghdad, IRAQ.**

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DETERMINATION OF DATE MOISTURE CONTENT A REVIEW

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ABSTRACT

A quick review of relevant hypotheses proposed by experienced researchers together with advanced drying technology development is undertaken. Regarding date fruit, a knowledge of its drying rate was beneficial to help designing an improved scheme for a determination of its moisture content. Basically, the AOAC standard method for sugary fruits is pursued. Mincing prior to mixing proved to be more effective in drawing out more moisture upon subsequent drying. Air passage set-up has been illustrated. The temperature, pressure and duration are fixed at 70°C, $\leqslant$ 50mm Hg and 6h, respectively. It is recommended that moisture content ought to be expressed on dry weight basis. Practical purposes may require the fresh weight basis. However, in either case the basis must be specified.

تحديد طريقة لتقدير محتوى رطوبة التمر

مهدي م . شكر

قسم النخيل والتمور مركز البحوث الزراعية والموارد المائية ـ بغداد ، العراق

الخلاصة

يغطي البحث مراجعة سريعة للفرضيات ذات العلاقة التي قدمها باحثون من

ذوي الخبرة بالاضافة الى التقدم الحاصل في الجوانب الفنية من عملية التجفيف، وبقدر ما يتعلق الامر بثمرة التمر فأن الالمام بمعدل سرعة التجفيف كان مجدياً للمساعدة في تصميم نظام محسّن لاستخراج المحتوى الرطوبي. وقد اتخذت الطرق القياسية التي اعدتها جمعية الكيمياويين التحليليين الرسميين (الاميركية) لتقدير هذا المحتوى في الثمار السكرية أساساً لذلك. وجد ان اتباع طريقة الفرم ثم الخلط قبل التجفيف يعطي مردوداً أعلى من حيث المحتوى الرطوبي. تضمّن العرض وسيلة ايضاح بخصوص تجفيف الهواء الداخل الى الفرن ذات الضغط المخلخل على أن تكون سرعة جريانه متناهية في البطء، الظروف الملائمة هي 70 °م (درجة حرارة)، 50 ملم Hg (ضغط) و6 ساعات (زمن). يوصي بأن يتم التعبير للنتائج على أساس الوزن الجاف. الا انه يجوز - بالنسبة لبعض الاعتبارات التطبيقية - احتساب المحتوى على أساس الوزن الطري؛ على أي حال فإنه ينبغي ذكر الاساس المتّبع.

INTRODUCTION

Moisture content (m.c) determination serves many objects such as consistency appraisal in dates and similar fruit classification, paste and powder technology, drying rate studies required by the unit operation 'drying' in chemical engineering and quality control procedures. As to food industry, it is indispensable in microbiological and biochemical assays to establish plant tissue/water relationship regarding equilibrium moisture content, water activity (a_w) and moisture sorption isotherms. Recently, it has found its way in the processed food trade especially in the international market. Importers are increasingly demanding stringent limitations on maximum m.c.

It is a known fact in food drying that 'drying' is preferred to 'dehydration' as one is not so sure that the operation is specific to moisture dismissal. Therefore, it would not be quite intriguing to keep on drying as long as there would be a differential coefficient of moisture (m.)with respect to time (t), $\triangle$ m. $\triangle$ t.

Generally water occurs in foods in three forms: (i) as a solvent or dispersing medium (ii) adsorbed as a thin mono-or poly-molecular layer or in fine capillaries, and (iii) in chemical combination as water of hydration. Part of the water in food is tightly held and known as bound water. It is characterized by being unable to dissolve added sucrose (14, 15). Consequently, difficulties in estimating its absolute content can well be envisaged. Further, fruits may contain sugars in moderate amounts if not distinctly high. Commonly, they have invert sugars with varying proportions of glucose to fructose. Needless to say they are responsible for the high affinity to moisture inherently contained in the tissue matrix. Any water vapour that happens to be in contact with a fruit surface is liable to be adsorbed. This unfavourable characteristic is accentuated whenever bruises are encountered in the various stages of handling and processing. The outcome is a tacky material that is still harder to dry and manipulate (8, 10).

To estimate the overall moisture content in a fruit, as many measures as can be practiceable have to be effected to overcome the inevitable difficulties met. Among the leading problems are: (i) decomposition of the other fruit components, (ii) loss of the volatile constituents, (iii) sensitivity of fructose to drying temperatures in the vicinity of 70°C, (iv) adequate and convenient drying equipment and material, (v) suitable conditions such as vacuum development and (vi) elapsed period. Authoritative sources on m.c. determination appear to advocate a six-hour period for dry sugar fruits since most of the moisture is evolved by then (e.g. 3); this period is quite practical in laboratory procedures too (7). The temperature is set at 70°C $\pm$ 1°C and the pressure within the oven is $\leqslant$ 100 mm Hg. Duplicate determinations should agree within 0.2%. One might be too skeptical about the adverse effect of heating on the examined material. Working on relative humidity media adjustment by saturated salt solutions, Taylor (24) advocated fixing the temperature at 30°C to minimize loss of vapours other than that of water. Chemicals can be resorted to in a desiccator under vacuum. Sulphuric acid, magnesium perchlorate and phosphorus pentoxide are quite effective moisture adsorbants. However, it may take two months to lose only 3/4 th of the moisture (14).

While Pixton and Warburton (20, 21) suggested drying for 24 h, 5mm Hg 70°C in the case of Turkish sultanas and quartered figs respectively, other workers favour timing of 10h and 48h with respect to dates (23, 10). As the time element is becoming increasingly more vital in laboratory techniques, a method has been developed whereby the oven temperature is raised to 140°C, the sample reduced to 0.2-0.3g and time cut down to 9 min only (16). In their experience, m.c. of dates and jam compare well with conventional methods which last for 6-12h. Other practical techniques that are feasible in the food industry are tabulated in Table 1 which shows their possible uniqueness. It is evident that these methods are non-destructable, quick and 'on line' facilities. The reader is directed to refer to relevant references for additional information.

Estimation scheme: Moisture content may either be expressed on the (1) fresh- or (2) dry- weight basis, i.e.f.w.b. and d.w.b respectively. While the first scheme has some limited uses, the second is more valid for the mere reason that it affords a smaller standard deviation for the same foodstuff. The equations indicated by (26) are:

Scheme 1*, f.w.b.	Scheme 2, d.w.b
$\text{M.c.} = \frac{\text{m. (g)}}{\text{m. (g)} + \text{s. (g)}} \times 100$	$\text{Moisture ratio} = \frac{\text{m. (g)}}{\text{s. (g)}}$
= g/100g ("as is")	= g/g

(m., moisture; s., solid; f, fresh; d, dry; w.b., weight basis)

Drying behaviour: In an extensive study on date drying behaviour, immediate entrance into the falling rate period had been manifested. Fig. 1 illustrates the nature of drying half dates under two relative humidity media in an air tunnel dryer. Not only constant drying rate is absent, but a steep rate is noticed at the earlier stage of the falling rate period (22). This is characteristic of diffusion controlled tissues, since they tend to hold moisture so tenaciously (12, 18).

Dates fall in the category of intermediate moisture foods or even in the

lower brackets (e.g. < 22% m.c.). Errors in m.c. estimations have more significance in the lower than in the higher range (26).

MATERIALS AND METHODS

In view of the standard method described earlier (3) and with due consideration of the other relevant sources, a system was set up that would suit dates as well as similar fruits.

Operation: A mechanical pump was used to lower pressure to $\leqslant$ 50 mm Hg with the help of air inlet adjustment. This air was dehumidified by passing through a series of desiccants namely silica gel, H_2SO_4 and P_2O_5, as shown in Fig. 2. The air flow rate was maintained as low as 2 bubbles/sec upon passing through the H_2SO_4. This light stream of dried air replaced moisture laden air from the oven which was exhausted out of the laboratory by the pump, Fig.3.

Through the use of thermocouples, the position that read equal to the thermostatic control – preset at 69 $\pm$ 1°C was identified to be the middle shelf. At the end of the drying period, the air outlet was closed, the pump turned off and 'dry' air let in. Thus, atmospheric pressure was restored.

Sample preparation, handling and weighing: All dates that were fairly representative to the whole batch were first pitted to prepare them for pasting. And this was accomplished according to consistency: (1) soft varieties, e.g. Halawi and Sayer were minced (and mixed when required) using an electric appliance, such as an ordinary household mincer/mixer, (2) dry varieities – including the cooked ones, e.g. Bedraayeh, Braim and Kibkaab were milled by a hammer mill. However, grinding energy was so high as to produce clumps instead of a spreadable paste. Mincing (and mixing) helped dissociate the stubborn aggregates and (3) semi-dry varieties were treated by either method, 1 or 2, depending on degree of softness, i.e. Deglet Nur and Zehdi were on the soft-while Ashresi was on the dry-side.

A stainless steel dish '8.5 cm diameter' with own cover, and spatula were pre-weighed. About 2g of pumice stone powder and about 5g of paste were then weighed in the dish to the fourth decimal point accuracy. Then 5 cm^3 ot distilled water were added to ease the paste/pumice mixture spreading.

Evaporation for about 5 min on a water bath ensued prior to oven drying. Three or four replicates were sufficient. Obviously, each replicate number must be born on the dish, spatula and cover. Upon cooling, all replicates were placed in a desiccator. Lost weight represented the contained moisture. Relating it to dry matter, in each replicate produced moisture ratio. When this figure is multiplied by 100, m.c. percentage is obtained. In other words, gram water/100g dry matter is estimated.

Hourly weighing was practiced following the series method in preference to the parallel method (22). Two successive-hour readings differing by $\leqslant$ 0.05% were indicative of this target. For 5g samples this meant an allowance of not more than 2.5mg. Duplicate determinations had to agree within 0.2%.

RESULTS

Taking into account the various merits of the vacuum oven method, a number of tests were run to exemplify the validity of the proposed methods to date paste and a date product, namely, powder. Tests on popular commercial varieties were chosen for this study, although the less commercial varieties behaved no differently.

The effect of further spreading of surface area on drawing moisture out of the sample was clarified as tabulated in Table 2. Time of attaining dry weight was the object of the second experiment. The maximum allowance of 0.05% between successive hourly weighings was the meausre. Results are presented in Table 3.

DISCUSSION

One can only theoretically visualize the existence of moisture side by side with dry matter in a fresh material. Yet, arriving at the technique whereby moisture can be totally isolated from living tissues has persistently been a point for conjecture. All reviewed applied methods inherently recognize that there always remains a residue of moisture regardless of the applied method or length of determination.

Liquid movement in solids of fibrous structure is by diffusion (12). Hence, convective methods of drying are ineffective. Preference of the

vacuum oven for m.c. determination in foodstuffs is attributed to the development of a partial pressure gradient alongside with heat (22). Consequently, any instrumentation, though capable of expediting the technique, is itself compared with the standard vacuum oven method to assess its precision. Hence, the term 'referee determination' had justly been ascribed to the vacuum method. It is suitable for the lower range of m.c. Dates are classified as intermediate moisture content foods with 22 – 24% moisture. However, the bulk of international trade is comprised of semi-dry varieties, e.g. Zehdi and Deglet Nur; they contain less moisture than 22% on average. This necessitates a deeper concern from the dehydration point of view (26). Relatively speaking, an error of 2% in a 15% m.c. substance is on average three times magnified when matched to the same error in one having 45% m.c. And this is especially pronounced in powder technology. In the light of this, an elaborate method was entailed.

Weighing accuracy, thorough spreading of sample, reduction of handling time especially during pitting, mixing, mincing and transferring to dishes and oven, choice of shelf and holding pressure at $\leqslant$50mm Hg. are by no means trivial procedural steps. Pumice stone or Al_2O_3 (alumina) powder was indispensible in facilitating spreading. Notwithstanding the indifference between the 'control' and the inert matter treated sample m.c. (23), moisture evaporation enhancing and case hardening preventing cannot be overlooked (14).

Neither extension of time nor raising up the temperature are hailed in this technique. As to time, Brown (7) could detect an additional 2.5% moisture in the second 6 hour interval of drying a dried fruit, and Van Arsdel (26) reported a difference of 2% moisture in the 34th hour following the first 6 hour of drying dried potatoes. In date trials less percentage in weight could be chased in the extended time. However, water is not totally responsible for this according to Barreveld (reported by '10'). Present work confirmed that a 6 hour period is both sufficient and efficient for date flesh and 4 hour for date powder. Nature of drying rate of dates back this postulation, e.g. dragging of the curve towards the last hours of drying. Temperatures higher than 70°C have an adversive effect on fructose, albeit (1)

opinion of unsuceptability of this sugar to decomposition at 140°C on the pretension of substantial reduction in time of exposure (to heat). The findings of these workers (16) raise many a speculation.

It could be ascertained that a good accuracy in replicate agreement for the date paste and powder was within reach. It is recommended that relating moisture weight (g) to dry stuff weight (g) would be multiplied by 100 as it is more apprehensible by researchers. This merely means transforming moisture ratio from a fraction, not exceeding unity, say 0.18 to a whole figure, say 18% (17, 22, 26) in low moisture foods.

It is worth mentioning at this stage that direct contacts with several workers at the Scientific Research Council and the Central System for Standardization and Quality Control, Baghdad, Iraq, revealed that their reporting on dry weight basis of moisture content in dates was actually not in accordance with the standard methods of the AOAC (3). More important is the fact that they have applied the f.w.b. formula (scheme 1, mentioned earlier) for what they termed as d.w.b.

It is anticipated that this method would be adopted by standardization offices to serve the date industry in the interest of traders and consumers. M.c. determination must be employed to stipulate ranges of the consistency scheme of classification (10) to aleviate overlapping between neighbouring groups.

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Table 1

Modern applicable techniques for moisture content determination in foods.

Technique	Samples tried	Range of m.c. detection	Features, equipment and materials	References
1. Near infrared spectrophotometry	Fruit & vegetable materials	2-99%	From dry powder to liquids. Specific to water. May give more accurate values than the vacuum oven technique	(13)
2.Refract-ive index	Prunes, raisins, figs & apricots	1-36%	In seconds. Calibration on basis of linear regression curve. Level of correlation P 0 001. Correction factor for date varieties listed.	(5), Rygg adapted by (10)
3. Radio frequency		Covers 0-80% moisture Accuracy 0.001-0.5%	In seconds. Preferred over methods based on conductivity (dc resistance) & capacitance (dielectric constant). Calibration chart needed.	(2)
4. Microware absorption	Food products	3-70% ± 0.25% accuracy	Equal or exceeding to laboratory measurements.	(25)

Technique	Samples tried	Range of m.c. detection	Features, equipment and materials	References
5. Nuclear magnetic resonance			Determination of bound and free water amount	(26),(9)
6. Dichromate oxidation				(26)
7. Distillation	Dates & other agricultural products		Solvent, toluene ($C_6H_5O_3$). 90 min. 20-25g sample. Compares very well with vacuum oven	Barreveld adapted by (10)
8. Dielectric constant (dec)	Food products	0-50%	But, less accurate according to- Water has a higher dec than conventional food materials, water: 80, carbohydrates: 3-5. Calibration essential.	(20) (6)
9. Karl Fischer (KF)	Dry stuff of egg, beans cake-mix, oats, potato starch, rice, wheat, garlic, onion, orange & tomato		Rapid, needs skill. Good agreement with standard vacuum oven method. KF reagent (I_2/pyridine/ anhydrous methyl cellulose/ anhydrous SO_2).	(26)

Technique	Samples tried	Range of m.c. detection	Features, Equipment and materials	References
10. Gamma radiation	Cereals & other food preparations	2 – 30%	Product size range dust – 19mm diameter. H_2O Kay system. Utilizes microwave technology based on gamma ray absorption. A transmission through the product technique	(11)

Table 2
Comparison between percentage moisture content of two methods in two varieties.

Preparation	Variety	% moisture content Replicate				
		1	2	3	4	Ave.
1. Mixing	Zehdi	13.7	13.7	13.8	14.1	13.8
	Halawi	16.6	16.6	16.7	—	16.7
2. Mincing followed by Mixing	Zehdi	14.4	14.6	14.7	14.7	14.6
	Halawi	16.9	17.0	17.0	—	17.0

Table 3
Standardizing drying time in m.c. determination of date paste and powder, Halawi variety.

Form	Reps.	Time (h)	Ave. % m.c.	Further loss in %m. c.
Thin (1mm) paste	3	5	19.83	—
	3	6	19.31	0.5
	3	7	19.27	0.04
Powder	3	4	1.58	—
	3	5	1.58	0

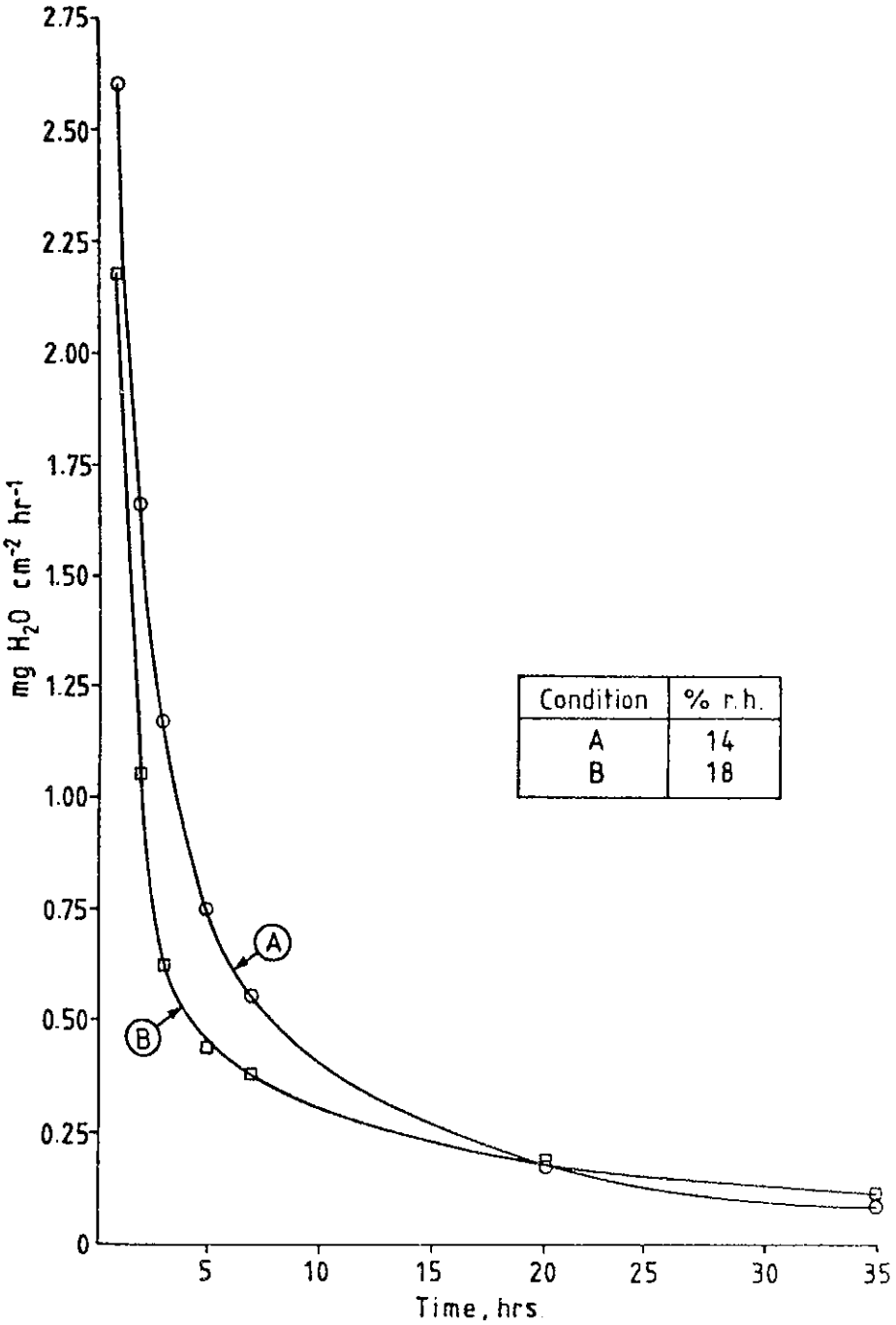

Figure 1. Drying rate against time, half Zehdi fruit

Figure 2: Air drying system for restoring atmospheric pressure in the vacuum oven (next figure):
(1) three silica gel tubes,
(2) concentrated H_2SO_4,
(3) P_2O_5, and
(4) silica gel bottle, serving as a trap meanwhile, and connects to the vacuum oven.

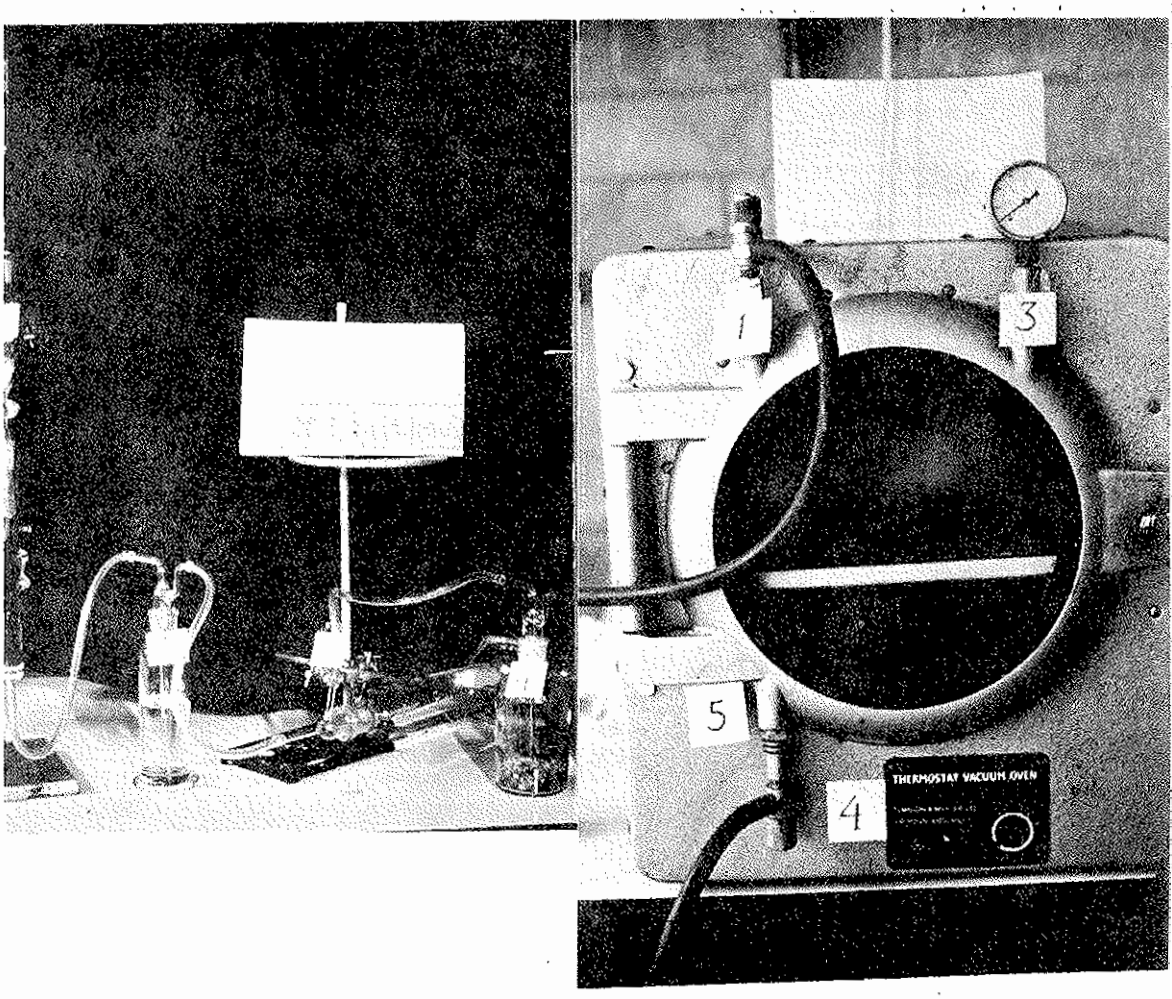

Figure 3: The vacuum oven: (1) air inlet control (leading from No. 4 in adjacent figure), (2) thermometer, (3) gauge reading in mm Hg, (4) temperature control and (5) air suction valve (leading to vacuum pump).

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IN VITRO SHOOT TIP DIFFERENTIATION IN *PHOENIX DACTYLIFERA* L[1].

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ABSTRACT

The actions of several auxins and cytokinins on development of *Phoenix dactylifera* L. seedling shoot tips and apical meristems were determined. Shoot tip explants consisted of the apical dome with two to four leaf primordia and varied in size from 0.5 to 1 mm^3. Meristems and tips were cultured on modified Murashige and Skoog medium (1962) containing 3g/1 activated charcoal, 0.1-300 mg/1 α-naphthaleneacetic acid (NAA), 2,4-dichlorophenoxyacetic acid, indole-3-acetic acid, 3-indolebutyric acid, 4-chlorophenoxyacetic acid, N^6- benzyladenine, 6-furfurylaminopurine, or $n^6-(\triangle^2$—isopentyl) adenine. Best consistent shoot regeneration occurred on nutrient media containing NAA. These shoots were recultured on nutrient media, devoid of charcoal, containing 0.1-10 mg/1 NAA or kinetin to enhance adventitious rooting and further shoot development. Best rooting was achieved with 0.1 mg/1 NAA with 63% of the shoots initiating adventitious roots after the first culture passage. Axillary bud outgrowths were occasionally obtained from shoots cultured on media containing 0.01 and 0.1 mg/1 NAA. Shoot tip techniques developed from seedling explants were adequate to establish rooted shoot tip cultures from adult trees and offshoots.

[1]*Mention of a trade mark or proprietary product in the paper does not constitute a gua-*

تطور الجزء القمي في نخلة التمر خارج الجسم الحي

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الخلاصة

حدد فصل عدة اوكسينات وساتوكاينيات على تطور الجزء القمي والانسجة المرسمية (المولدة) لبادرات نخلة التمر. احتوت النبيتات (explants) المأخوذة من الجزء القمي على الجزء الطرفي مع 2 - 4 بادئات ورقية (Leaf Primordia) واختلفت حجومها ما بين 0.5-1.0 ملم. زرعت الانسجة المولدة والقمم في بيئة موراشيجي وسكوج المحورة (1962) المحتوي على 3 غم/لتر من الفحم المنشط 0.1 – 300 ملغم/لتر من (NAA)، 2, 4-D، اندول -3 حامض الخليك، 3- حامض اندول بيوتيريك، 4 كلورو فينوكسي حامض الخيك N^6 بنزيل ادينين، 6- فورفوريل امينو بيورين أو N^6 – Δ^2 ايزوبنتيل ادنين، حصل احسن تطور (اخلاف) على الوسط الحاوي على (NAA). اعيد زراعة هذه الاخلاف على وسط غذائي خال من الفحم وحاو على 0.1 – 10.0 ملغم/لتر NAA او كاينتين لتسريع التجذير العرضي والمضي في تطور الجزء القمي. تم الحصول على احسن تجذير بأستعمال 0.1 ملغم/لتر NAA حيث ان 63% من الاجزاء القمية بدأت بتكوين الجذور العرضية بعد مرور الزراعة الاولى. تم الحصول على نمو البرعم الطرفي احياناً من الجزء القمي المزروع في وسط يحتوي على 0.01 و 0.1 ملغم/لتر NAA. ان تقنيات الجزء القمي المتحصل عليها من نبيتات (explants) البادرات كانت كافية ومناسبة لاستعمالها في حالة اشجار النخيل البالغة والفسائل.

INTRODUCTION

The need to rapidly clone date palms is important because palms are slow growing trees which require several years to mature to the adult fruiting stage from a germinated seed. Propagation of palms through tissue culture techniques has been achieved primarily by the production of plantlets from embryogenetic callus, for example date palm (1, 19, 20, 28, 30, 29), oil palm (3, 18), and coconut palms (5,7). Asexual embryogenetic callus has been obtained from a variety of somatic and zygotic explant sources.

Plantlets also have been produced directly from the *in vitro* organogenesis process in palms by the production of roots from cultured shoots (25, 28), and shoots from cultured roots (26). Staritsky (27) culturing oil palm shoot tips obtained some rooting on a modified Miller medium containing 5 mg/1 α-naphthaleneacetic acid (NAA) or indoleacetic acid (IAA). Similarly, cultured date palm shoot tips often enlarged, initiated leaves, and exhibited infrequent root production on a modified (15) medium containing an auxin (28). Date palm crowns, including the young leaves, mantle meristem, and the apical meristem, were excised from offshoots and produced lateral bud outgrowths (17, 22).

Plantlets derived from callus, in other species, have sometimes exhibited genetic variation different from the parental clone (6,8, 13). Plantlets produced through tissue culture *via* callus should be suspected as being potentially aberrant until their clonal nature is established through the comparison of fruit and vegetative growth characteristics with the parental clone from which the explant tissue was obtained.

Alternatively, clonal propagation from plant tissue culture is most often achieved through multiplication and/or rooting of tips and buds (4, 14). The mechanism for the production of rooted plantlets from palm tips and buds is not fully understood. Therefore, we planned and conducted this study to develop this type of micro-propagation for the date palm. Production of multiple shoots from the shoot tip region should provide clonal date palm plantlets. Shoot tip explant material employed in this study was derived from seedlings, because procuring a large number of shoot tips

necessary for research from adult date palms and their offshoots was impractical.

MATERIALS AND METHODS

Plant Material. Date palm, *Phoenix dactylifera* L., shoot tip explants were obtained from 4-6-month-old seedlings of 'Deglet Noor' cultivar. Seeds were germinated in 1:1 (v/v) peat-vermiculite in a greenhouse in Indio, California. Shoot tip cultures were prepared by excising the terminal 2 cm from washed defoliated seedlings. Explants were soaked in a cold anti-oxidant solution (150 mg/l citric acid and 100 mg/l absorbic acid) before the surface sterilization treatments. Explants were surface sterilized for 15 min with 0.25 to 2.63% (w/v) sodium hypochlorite (NaOC1), containing one drop of Tween-20 per 100 ml. In some cases explants were then treated with 3 rinses with sterile distilled water. Another post-treatment used sometimes was a five-second NaOC1 dip before planting.

Removal of subtending leaves to obtain shoot tips was performed under a dissecting microscope at a magnification of 60x. Shoot tip explants were excised from surface-sterilized tips by making four successive cuts at right angles around the apical dome followed by a final cut immediately beneath the dome. Shoot explants varied in cross-sectional area from 0.5 to 1 mm^2. Shoot tips were cultured with two to four primordial leaves with and without subtending bases. To determine the optimum tip explant size to culture *in vitro,* six explant types were tested that included: the apical dome, apical dome with two leaf primordia, apical dome with four leaf primordia (shoot tip), shoot tip with a base of meristele tissue, shoot tip with base and numerous subtending leaves, and the apical dome only with a base.

Nutrient Media: The basal nutrient medium employed throughout this study contained Murashige and Skoog inorganic salts, 170 mg/l $NaH_2PO_4 \cdot 2H_2O$, 100mg/l meso-inositol, 0.4 mg/l thiamine. HCl, 3% (w/v) sucrose, 40 mg/l adenine sulfate. $2H_2O$, 0.3% activated charcoal, and 0.8% (w/v) Phytagar. Auxins NAA, 2,4-dichlorophenoxyacetic acid (2,4-D), 4-chlorophenoxyacetic acid (p-CPA), 3-indolebutyric acid (IBA), or IAA, and cytokinins N^6-benzyladenine (BA), 6-furfurylaminopurine (kinetin),

and N^6—(Δ^2-isopentyl) adenine (2ip) were included in the nutrient media at 0.0, 0.1, 0.3, 1.0, 3.0, 10, 30, 100, or 300 mg/1. Ten milligrams per liter NAA and 0-300 mg/1 BA were tested in combination on shoot tips consisting of the apical dome with two to four leaf primordia. Apical dome explants were also cultured on basal nutrient medium, devoid of charcoal, containing various combinations and concentrations of NAA (0.0, 0.01, 0.1, 1.0 mg/1) and BA (0.0, 0.1, 1.0, 10 mg/1). Two separate experiments were performed with these media: 1) Explants were transferred to fresh media 1 week after initiating culture, and 2) Explants remained on the original media throughout the study. Well developed shoots 4 to 5 months of age, derived from shoot tips cultured on basal nutrient media with 10 mg/1 NAA, were cultured on nutrient media, devoid of charcoal, containing 0.0, 0.01, 0.1, 1.0, and 10 mg/1 NAA or kinetin to enhance further shoot differentiation and adventitious root initiation. The pH of all media was adjusted to 5.7 $\pm$ 0.1 with 0.1 N HC1 or NaOH, before addition of agar. Media were dispensed into 25 $\times$ 150-mm culture tubes in aliquots of 25 ml per vessel, and tubes were capped with Bellco kaputs. Media were then autoclaved for 15 min at 121°C and cooled while slanted at a 45° angle.

Culture Conditions: At least 15 cultures were employed per treatment. Cultures were incubated in a temperature-controlled room at constant 29°C $\pm$ 1°C, and were subjected to 16 hours' daily exposure of 1.1 Klx Gro-Lux light. Data collection and reculturing were performed at 8-week intervals.

RESULTS

Surface Sterilization Method. The effect of various surface sterilization methods on shoot tip survival is presented in Table 1. The best disinfestation method consisted of treating explants with 2.63% NaOC1 solution for 15 min followed by 3 rinses with sterile distilled water. Treatments of explants with lower concentrations of NaOC1 solutions (0.25 and 0.48%) resulted in proportionally higher rates of contamination compared with explants treated with high concentrations of NaOC1 solutions (0.87 and 2.63%). Explant survival was markedly reduced in all treatments when the subsequent rinsing step was omitted. Treating tips with a NaOC1 dip be-

fore planting was not necessary and was even adverse for subsequent shoot development (Table 1).

Effect of Explant Size: Three separate, similar experiments were performed by culturing shoot tip explants of various sizes. Six types of shoot tips were cultured on a basal nutrient medium containing 10 mg/l NAA to determine a satisfactory explant choice to culture in future experiments (Table 2). Some growth occurred for all shoot tip explant types tested with the exception of shoot tip devoid of leaves. Explants consisting of the apical dome only, and the apical dome with two leaf primordia consistently exhibited the best growth *in vitro* compared with other treatments (Table 2). However, shoots derived from apical dome only explants were often deformed and had irregular, twisted leaves. Usually, shoots derived from the other explant tip sources grew erect like a seedling (Plate 1). In addition, there was a 2-week lag between the initial planting of the apical dome and visible formation of leaves compared with other tip explants tested. Based on this study, the shoot tip explant selected for later experiments consisted of the apical dome with two to four leaf primordia. Shoots derived from these explants were consistently uniform and usually produced shoots that varied in length from 3 to 7 cm at the end of the first culture passage. No benefit resulted from culturing larger shoot tip explants; in fact, such explants gave consistently poorer shoot formation than smaller ones and some exhibited erratic growth responses depending on the experiment (Table 2).

Effects of Growth Regulators. Addition of growth regulators to nutrient media was not necessary to stimulate shoot proliferation. Some levels and types of auxins, however, appeared to enhance shoot development. Better shoot tip development occurred with nutrient media that contained 10 and 100 mg/l NAA than with other growth regulators tested (Plate 2; Table 3). Though not shown in Table 3, shoot proliferation was notably inhibited by IBA and p-CPA for most concentrations tested. Shoots derived from explants cultured on 2,4-D were consistently smaller than those from NAA treatments; however, the number of leaves produced per culture did not differ significantly in most cases. In addition, the length and number of

leaves produced per shoot from 2,4-D treatments were less than those obtained from explants cultured on 10 mg/1 NAA. The effect of IAA on shoot development was negligible. Controls and treated cultures, regardless of the IAA level tested, showed little difference in growth responses.

Cytokinins did not appear to improve shoot development compared with surface-sterilized control cultures (Table 3). To further improve shoot development *in vitro,* shoot tips were cultured on basal nutrient media containing 10 mg/1 NAA and various concentrations of BA. However, addition of BA did not improve shoot development over medium containing only 10 mg/1 NAA. Only tips cultured with 0.01 and 0.1 mg/1 BA, exhibited some shoot development. Media containing high levels of BA, 100 and 300 mg/1, often stimulated callus and root formation at the base of the shoot tips.

Apical dome explants grew and produced leaves on basal nutrient media that were devoid of charcoal, but contained various combinations of NAA and BA (Table 4). Most explants that were transferred to fresh nutrient culture media after 1 week showed higher survival and shoot growth rates than apical meristems that were not prematurely recultured (Table 4). Roots were formed from explants cultured on nutrient media containing 0.01 or 0.1 mg/1 NAA with 0.1 or 1.0 mg/1 BA. Best shoot development occurred on media containing 0.01 or 0.1 mg/1 NAA in combination with lower levels (0.0 to 1.0 mg/1) of BA. Invariably, growth and survival of apical domes was very low with 1 mg/1 NAA regardless of BA concentrations.

Root Induction. Adventitious roots were infrequently produced from shoot tip cultures from the previous experiments. For example, shoots cultured on nutrient media containing 10 mg/1 NAA exhibited about 10% rooting. Enlarged shoots, about 2 to 4 months old, derived from shoot tips originally cultured on basal nutrient media containing 10 mg/1 NAA, exhibited prolific adventitious rooting when recultured to nutrient media that were devoid of charcoal, but contained 0.01 or 0.1 mg/1 NAA (Plate 3).

Root development and morphology produced by the two NAA concentrations were however somewhat different. Roots produced on media

containing 0.1 mg/l NAA were consistently longer (1.5 to 6.0 cm), thicker in diameter (< 1.0 mm), and more vigorous in appearance after 8 weeks in culture than roots produced from shoots on 0.01 mg/lNAA. Generally shoots composed of two or more leaves with lengths 3.5 cm or longer rooted better than smaller shoots (Table 5).

Axillary Bud Outgrowths. Multiple shoots occurred in about 10% of the cultures planted on nutrient media devoid of charcoal containing 0.1 mg/l NAA and at a somewhat lower frequency from tips cultured on charcoal containing media with 10 mg/l NAA (Plate 4). The source of these additional shoots was the outgrowth of axillary buds and they occurred adjacent to the tip.

Culturing Older Shoot Tips. Transfer of the shoot tip technique developed for seedling date palms to physiologically and chronologically older shoot tip explants is possible (Table 6). Rooted shoot tips have been obtained from both adult date palms and offshoots.

DISCUSSION

Micropropagation with isolated meristems and shoot tips is often performed to maintain the genetic identity of the parent clone (4, 14). The present investigation has shown that plants were produced from date palm excised shoot tips comprised of the apical meristem and two to four adjacent leaf primordia by regeneration of well-developed shoots which then formed adventitious roots.

Surface disinfestation of explants has been noted to be a paramount problem in palm tissue culture (28). We found that 2.63% NaOC1 treatments were necessary to obtain contaminant-free cultures. Further development and visible outgrowth of internally lodged contaminants occurred throughout our experiments in about 10% of the cultures. These contaminants appeared to be located within the internal plant organs because even the smaller tip explants were susceptible to their occurrence.

Browning of palm tissues and nutrient media has been reported to be ubiquitous (2, 7, 22, 25, 28, 30, 31). Activated charcoal was included in the nutrient media to combat this problem. Due to the presence of this ad-

sorbent, growth regulators were tested at unusually high levels for tissue culture studies, for example 10 and 100 mg/1 mg/1 NAA, to obtain morphogenetic effects. Browning of palm tissue could be minimized without addition of charcoal to the nutrient medium by employing small explants, that is, apical meristem, and reculturing explants to fresh medium after a short period of incubation. Apparently, the most lethal browning components are produced during the initial culture of the explant.

Prolific shoot growth was obained from a variety of shoot tip explant sources, but particularly from the apical dome with two adjacent leaf primordia. Culture of large tip explants did not improve survival and growth *in vitro*. Culture of the apical dome only, though feasible in date palm, often resulted in the formation of an initially aberrant shoot. Possibly the apex was damaged during the excision and planting processes. Such aberrations have occurred in the meristem culture of other plant species (12). Uniformly produced shoots were more easily obtained from the apical dome cultured with two or more adjacent leaf primordia. Similarly, (11), using potato meristem and tip cultures, obtained more plantlets when the leaf primordia were included than when they were not.

Among the auxins tested, NAA particularly at the 10 mg/1 level, was superior to the other growth regulators tested in accelerating shoot tip growth. Similarly, our findings conform with those of other investigators working with various plants (9, 23, 16). Inclusion of cytokinins in the nutrient media did not improve shoot development from tip explants. Investigations showed (24) that tissues from dicotyledonous plants are generally more dependent on an external cytokinin supply for growth than are tissues from monocotyledonous plants. According to (26), addition of an exogenous cytokinin to the nutrient medium was unnecessary and even inhibitory to meristem development. Perhaps, the date palm meristem either synthesises an adequate cytokinin supply or does not require any exogenous cytokinin-like growth regulator for its initial development.

Prolific rooting from date palm shoots was obtained on a medium devoid of charcoal, supplemented either with 0.1 mg/1 NAA only, or 0.1 m g/1 NAA in combination with 0.1 or 1.0 mg/1 BA. Similarly, (16) rooted

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Table 1

Effect of surface sterilization methods on percent survival of contaminant-free date palm shoot tips.[1]

Method	Post-treatment			
NaOC1 solution (%)	Control (no sterile water rinse or NaOC1 dip)	5-second NaOC1 dip only	3 Sterile water rinses only	Sterile water rinse and 5-second NaOC1 dip
2.63	53	53	94	87
0.87	33	20	54	47
0.48	14	33	47	40
0.25	7	13	33	20

[1]All explants soaked for 15 minutes; data recorded after 8 weeks in culture.

Table 2

Percent survival of date palm shoot tips and meristem explants *in vitro*[1]

Explant *Type*	Explant survival (%)/ Date of culture		
	Oct. 7	*Oct. 14*	*Nov. 20*
Shoot tip with base and leaves	80	16	23
Shoot tip minus base	30	30	25
Shoot tip minus leaves	0	0	0
Apical dome with 4 leaf primordia	50	69	56
Apical dome with 2 leaf primordia	50	71	70
Apical dome only	65	67	73

[1]All explants cultured on basal nutrient medium containing 10 mg/1 NAA; data recorded after 8 weeks in culture.

Table 3
Influence of growth regulators on the growth of date palm shoot tips.[1]

Test levels (mg/1)	Shoot growth (%)					
	Growth Regulator Type					
	NAA	2,4-D	IA	Kinetin	BA	2ip
0.0	58	50	42	80	58	80
0.1	58	—	—	60	67	60
0.3	67	47	33	40	58	40
1.0	58	53	42	53	50	53
3.0	67	53	33	66	58	66
10.0	75	53	33	73	33	73
30.0	—	67	50	—	33	—
100.0	75	13	—	60	42	60
300.0	58	6	25	53	42	53

1. Shoot tip explants were cultured on basal nutrient medium with 0.3% activated charcoal containing various growth regulators.

Table 4
Influence of α-napthaleneacetic acid and benzyl adenine on shoot proliferation from date palm apical meristems. [1]

Growth Regulators (mg/1)		Shoot growth (%)	
NAA	BA	Original culture[2]	Reculture[2]
0.0	0.0	30	50
	0.1	50	70
	1.0	50	70
	10.0	40	40
0.01	0.0	30	50
	0.1	40	40

Growth Regulators (mg/l)		Shoot growth (%)	
NAA	BA	Original culture[2]	Reculture[2]
	1.0	40	70
	10.0	30	30
0.1	0.0	30	80
	0.1	30	60
	1.0	30	60
	10.0	40	30
1.0	0.0	30	0
	0.1	0	0
	1.0	0	20
	10.0	20	10

1. All explants cultured on a modified Murashige and Skoog nutrient medium minus charcoal and supplements with NAA and BA; data recorded after 8 weeks in culture.
2. Explants were either allowed to remain on the original nutrient medium throughout the study (Original culture) or recultured after 1 week to fresh nutrient medium (Reculture).

Table 5

Percentage of root production in date palm shoots cultured on a basal nutrient medium with various concentrations of NAA.

Shoot type (# leaves/leaf length, cm)	Concentration of NAA (mg/l)				
	0	0.01	0.1	1	10
> 2 / 3.5 ± 0.3	0	54	63	22	10
2 / 2.7 ± 0.2	0	50	45	0	0
1 / 1.8 ± 0.5	0	0	0	0	0

Table 6
Morphogenesis obtained from shoot tip cultures of date palm derived from various explant sources.[1]

Explant sources	Shoot growth/ culture (%)	Shoot length/ culture	Leaves/ culture
Adult tree[2]	85	2.12 ± .71	1.5 ± .5
Juvenile[2]	80	2.75 ± .69	2.5 ± .6
Offshoot			
Seedling	100	2.35 ± .65	2.0 ± 0.0

1. Shoot tip explants consisted of the apical dome and adjacent leaf primordia; results taken 8 weeks after planting. Shoot tips were planted on a modified Murashige and Skoog medium containing 10 mg/1 NAA.
2. Adult tree consisted of an 8-year-old fruit-bearing seedling derived from 'Deglet Noor' fruit. Offshoot was obtained from adult tree and estimated to be 4 years old.

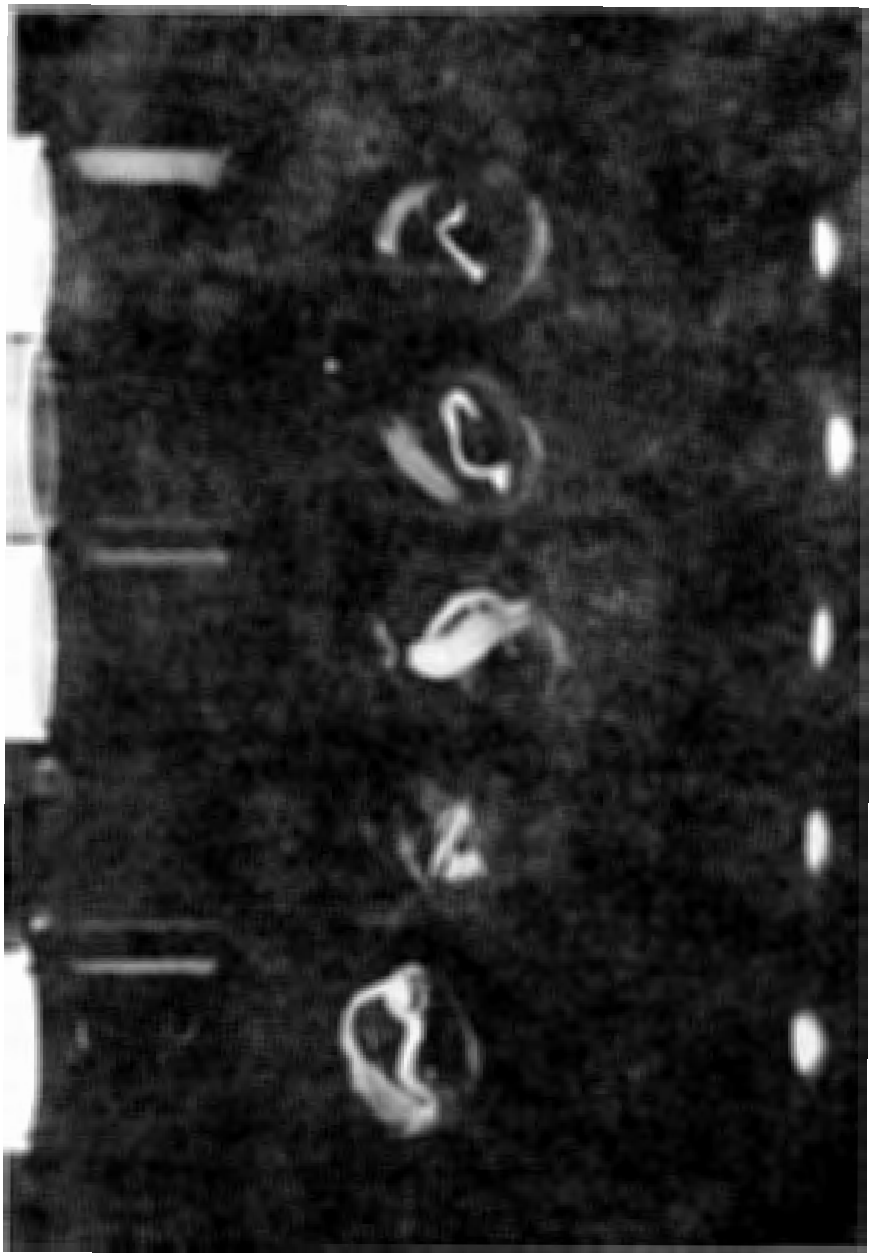

Plate 1. Growth responses obtained from various date palm shoot tip explants after 8 weeks in culture Source of original explant from left to right: apical dome and two leaf primordia, apical dome only, shoot tip with base removed, shoot tip with base, and shoot tip with base and additional subtending leaves.

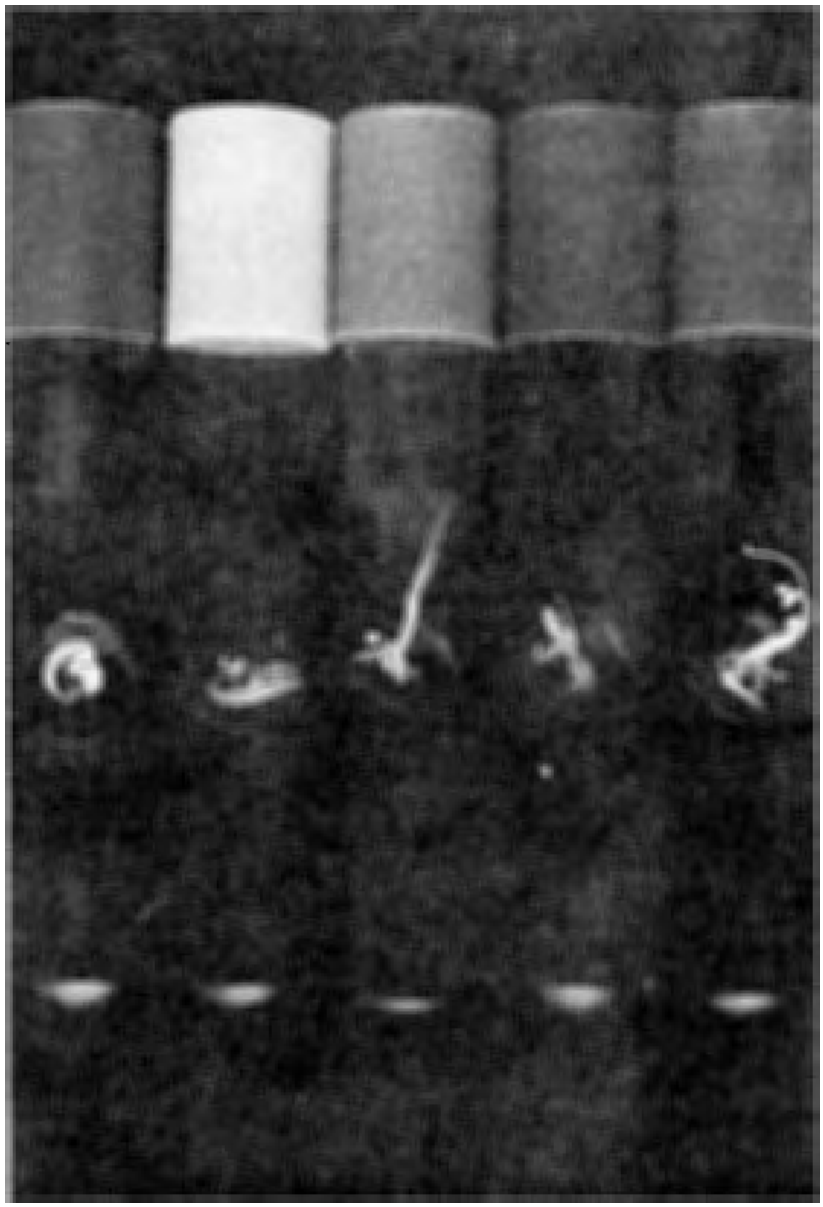

Plate 2. Morphogenetic effect of NAA on date palm shoot tips after 8 weeks in culture. Explants were cultured on a modified Murashige and Skoog nutrient medium containing (from left to right): 0.0, 0.01, 10, 0.1 and 1.0 mg/l NAA. Note that the center culture containing 10 mg/l NAA produced the largest shoot.

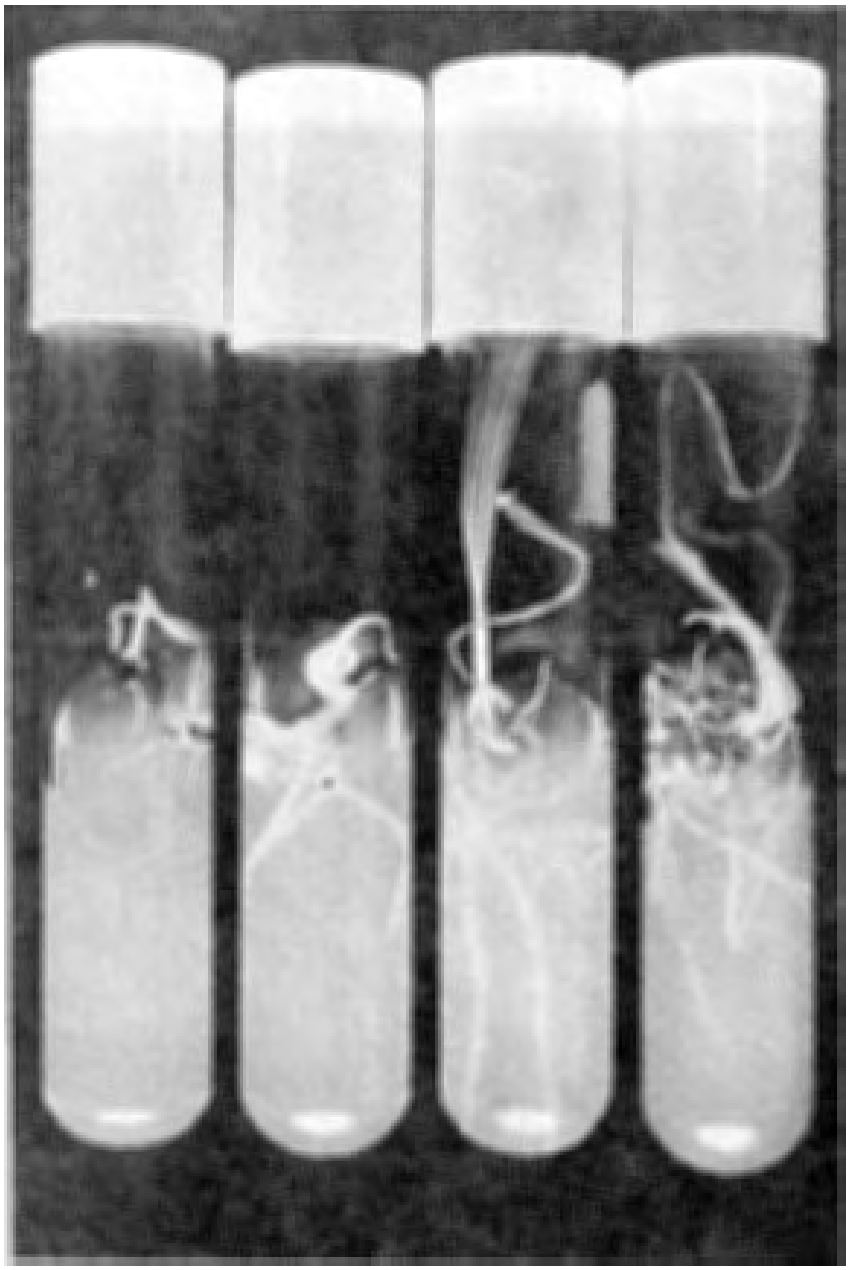

Plate 3. Comparison of the rooting responses obtained by reculturing date shoots to media containing 0.01 and 0.1 mg/l NAA. First two cultures to left contain 0.01 mg/l NAA; second two cultures on right contain 0.1 mg/l NAA. Note that both shoot and root development was enhanced by culture on media containing 0.1 mg/l NAA.

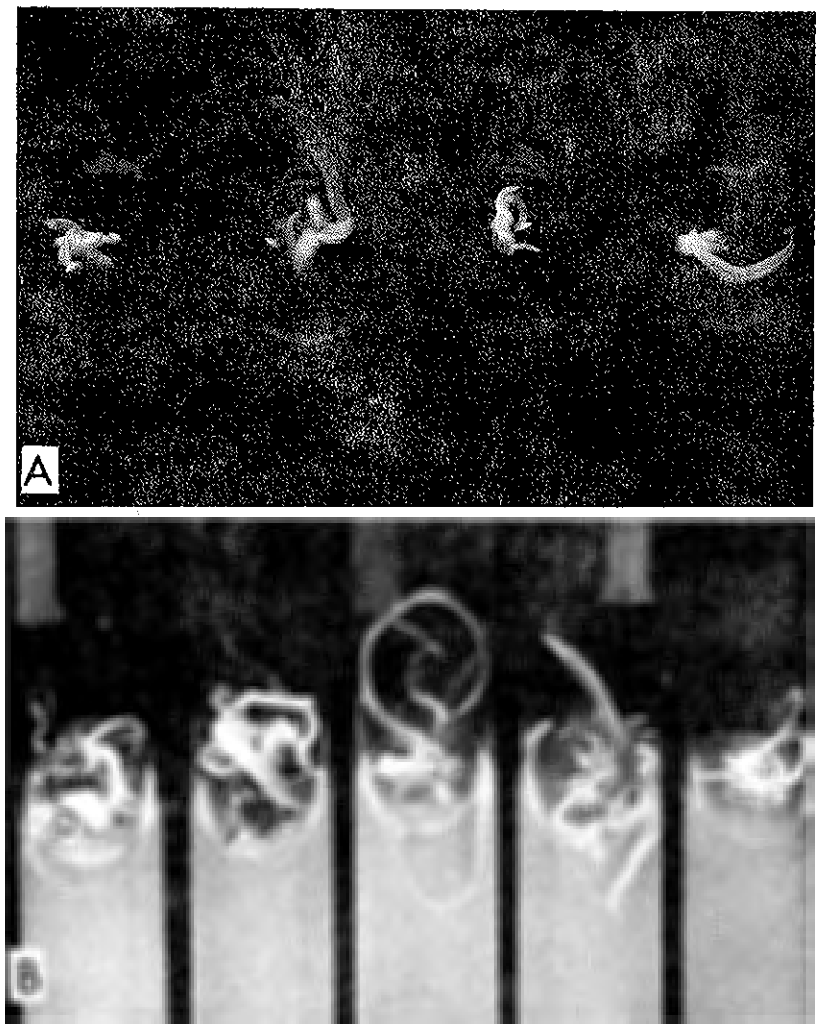

Plate 4. Examples of axillary bud outghrowths obtained from date palm shoot tip cultures. A. Eight week-old cultures initiating additional shoots on nutrient medium containing 10 mg/1 NAA and 0.3% charcoal. B. Sixteen week-old cultures with enlarged multiple shoots and adventitious roots cultured on nutrient medium containing 0.1 mg/1 NAA.

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PHYSICAL AND CHEMICAL CHARACTERISATION OF THE MAJOR DATE VARIETIES GROWN IN SAUDI ARABIA
II. SUGARS, TANNINS, VITAMINS A AND C

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ABSTRACT

Sugars, tannins, vitamin C and vitamin A analyses were done on fifty-five date varieties (*Phoenix dactylifera* L.) grown in Saudi Arabia at two different stages of maturity, Khalal (mature-colour) and Tamar (ripe). Results of the chemical and high pressure liquid chromatography analyses showed that the total sugar as well as reducing sugar contents were higher in the Tamar stage than at the Khalal stage Sucrose content was higher at the Khalal than at the Tamar stage. Glucose and fructose were the only sugar monomers detected. In general, the majority of the local date varieties investigated were found to be the soft-date type characterized by the dominance of reducing sugars. Tannin content of the dates was substantial at the Khalal stage (1.2-6.7%) and then decreased at the Tamar stage (0.6-3.2%). In general, vitamin C content was low but higher at the Khalal stage (1.8-14.3 mg%) than the Tamar stage (1.1-6.1 mg%). The concentration of ß-carotene expressed as International Units of vitamin A was substantial at the Khalal stage of maturity but very low or absent at the ripe Tamar stage suggesting that dates are a poor source of vitamin A.

المواصفات الكيميائية والفيزياوية لأصناف التمور الهامة بالمملكة العربية السعودية

I.I. السكريات، التانينات، الفيتامينات A و C

و . ن . صوايا، و . م . م . صافي، ل . ت . بلاك، أ . س . ماشدي وم . م . المحمد .

المشروع الاقليمي لمركز البحوث الزراعية والمياه/وزارة الزراعة والمياه

ص . ب 17285 الرياض ـ المملكة العربية السعودية

الخلاصة

أجريت التحاليل لتقدير السكريات، التانينات، فيتامين C وفيتامين A لخمسة وخمسون صنفاً من التمور السعودية في طوري الخلال والتمر . أظهرت هذه التحليلات أن السكريات الكلية المختزلة كانت أعلى في طور التمر عنه في طول الخلال. أما محتويات السكروز فكانت أعلى في طور الخلال. وعلى العموم فقد تم الكشف عن الكلوكوز والفركتوز من السكريات الأحادية فقط. وبصورة عامة فقد وجد بأن أغلبية الأصناف التي درست هي من أنواع التمور اللينة (الرطبة) والتي تتميز بسيادة السكريات المختزلة.

كان محتوى التانين كبيراً في طور الخلال (2% - 6.7%) ثم انخفض في طور التمر (0.6 - 3.2%) وعموماً فان كمية فيتامين C كان واطئاً ولكنه كان أعلى في طور الخلال (1.8 - 14.3 ملغرام ٪) عما هو عليه في طور التمر (1.1 - 6.1 ملغرام ٪) . كان تركيز البتاكاروتين موضحاًكوحدات دولية لفتامين A كبيراً في طور الخلال وقليلاً جداً أو معدوماً في طور التمر مما يشير الى أن التمر مصدر فقير لفتامين A .

INTRODUCTION

In many desert areas, dates have been used as a staple food for hundreds of years (13). In general, dates are considered as high energy foods due to

their high sugar content. They are a poor source of vitamins but contain significant amounts of certain minerals such as iron and potassium (5). Tannins occur in substantial amounts in green fruits and impart high astringency thus making the fruits unpalatable at this immature stage (22). The nature and amount of sugars in various date varieties growing in different parts of the World have been reported (4, 7, 8, 12, 21). In Deglet Noor dates, which is the dominant variety in the U.S., sucrose or cane sugar constitutes 60-80% of the total sugar at the ripe stage (16). On the other hand, many of the invert sugar varieties or soft dates contain comparable amounts of sucrose before ripening to those of the Deglet Noor, but all or nearly all of the sucrose is later converted into invert sugars during ripening (15). Many of the soft-date varieties are abundant in various Arab countries such as Iraq, Saudi Arabia, Egypt, Algeria, Tunisia, Yemen and Oman.

The limited information on the sugars of the important date varieties grown in Saudi Arabia is not adequate and data is almost non existent with respect to vitamins and tannins. This study was, therefore, conducted to characterize the sugar content as well as to determine the levels of tannins and two vitamins, namely, vitamin C and ß-carotene (Provitamin A) in 55 major date varieties grown in the four provincial regions of the Kingdom of Saudi Arabia. The investigation was done at two different stages of maturity; a) Khalal, which is the stage when dates begin to change the green colour to yellow, red-pink, yellow-scarlet or yellow spotted with red and, also reach maximum size and weight and b) Tamar, the stage when the fruit contains the maximum total solids and is completely softened and brownish in colour. The four provincial regions, comprised of nine areas, from which the dates were collected are: a) Central and Northern Regions (Gassim, Al-Kharj and Hail), b) Eastern Region (Hofuf and Qatif, c) Western Region (Al-Madina) and d) Southwestern Region (Wadis Fatmah, Khleis, Wadis Rania, Tarabah and Bisha).

MATERIALS AND METHODS

Collection of Samples

Collection of date samples for sugars, tannins and vitamins analyses was

done as previously described (19).

Preparation of Samples

Three hundred grams of the fresh fruits were destoned and the calyces removed. They were then cut into small pieces, mixed well and weighed. A composite sample of 30 g was used for each of the analyses of the sugars, tannins, vitamin C and ß-carotene.

Analytical methods

The tannins, total and reducing sugars and vitamin C and ß-carotene were determined on the freshly collected fruits according to AOAC Official Methods (2). The sugar monomers were determined by weighing accurately 30 g of the sample into a sample cup of a Sorvall Omni-mixer/grinder which operates at 16,000 r.p.m. Exactly 200 ml of distilled water was added and the samples were ground for 5 minutes. The date/water mixture was shaken for 1 hour to dissolve all sugars in the water. The extract was filtered through No. 2 Whatman filter paper discarding the first few milliliters which were cloudy. The clear date extract was analyzed on a Waters ALC 201 liquid chromatograph equipped with a differential refractive index detector. The column used for the sugar separations was a Bio Rad HPX-42 gel filtration column with water as the elution solvent. The area of the recorder peaks of each sample was compared with the peaks of a standard water solution of glucose/fructose/sucrose.

RESULTS AND DISCUSSION

Results of the sugar tannin, vitamin C and ß-carotene (pro-vitamin-A) analyses of the 55 date varieties are presented in Tables 1, 2, 3 and 4.

The total sugar content of the majority of the varieties at the Tamar stage ranged between 70-80% of their dry weight with only a few exceptions. At this stage, the maximum total sugar was found in Hulwa variety (Table 3) from the Western Region and the minimum in Khsab variety (Table 2) from the Eastern Region. On the other hand, the total sugar contents in the Khalal stage were, in general, less than those at the Tamar

stage and ranged between 41-88% with eleven varieties containing 40-60%, forty varieties 60-80% and only three varieties 80-90% total sugars. Varieties Hallaw (Table 2) from Eastern Region and Anbara (Table 3) from the Western Region contained the maximum and the minimum total sugars, respectively, at the Khalal stage. The observed increase in the total sugar content in almost all the varieties analysed is in line with the results reported by other workers (3, 6, 25).

The reducing sugar contents, in general, showed trends similar to that of the total sugar content being more in the Tamar stage as compared to the Khalal stage. The reducing sugar contents for the 55 varieties ranged between 29-85% in the Tamar stage and between 8-81% in the Khalal stage. Moreover, the concentrations of the reducing sugars were dominant in all of the varieties at the Tamar stage except for Sukkarat Al Shark (Table 3) and Sukkari (Table 1) varieties, which contained more sucrose than reducing sugars at this stage.

On the other hand, the sucrose contents were found to be much higher in most of the varieties at the Khalal stage ranging between 1-70% with the majority containing between 10-30% and only seven varieties containing relatively higher amounts (35-70%). As the fruits of the various date varieties passed into the Tamar stage, the sucrose contents dropped to low levels in most of the varieties and ranged between 0-2% in 44 varieties, 2-10% in six varieties and 11-43% in only three varieties. Only two varieties, namely, Sukkarat Al Shark and Sukkari, accumulated more sucrose during this period and contained more sucrose at the Tamar than Khalal stage.

Evidently, the increase in the concentration of the reducing sugars from the Khalal to the Tamar stage and their predominance at the Tamar stage indicated that the majority of the important date varieties in Saudi Arabia are of the soft-type which are characterized by a high concentration of reducing sugars at the Tamar stage (1, 9, 10, 16). The finding that many of the varieties showed substantial amounts of sucrose at the Khalal stage which decreased to very low amounts at the Tamar stage agrees with results reported on many of the soft-date varieties (15, 22, 23) but are dif-

ferent to those obtained with dry-date varieties (3, 6, 10, 15). The difference in the sucrose content which is low in the soft-dates and high in the semi-dry and dry types of dates, is attributed to the difference in the activity of the splitting enzyme, invertase, which is more active in the soft-type varieties than in the dry ones (22). The conversion of sucrose to glucose and fructose by the invertase is usually carried out to completion or near completion in soft-date varieties, but is only partially hydrolysed with the dry and/or semi-dry ones (16). There were only two varieties, Sukkarat Al Shark (Table 3) and Sukkari (Table 1) which contained relatively higher concentrations of sucrose than reducing sugars at the Tamar stage and, therefore, fell within the same group of semi-dry and dry varieties that have been reported in the literature (3, 6, 10, 15). The results obtained are in good agreement with those reported by Hussein et al (9, 19, 11) and Hussein and Al-Zeid (8) on some Saudi Arabian date varieties.

With respect to the identity of the sugar monomers, glucose and fructose were the only detected monomers in all the varieties analysed. Since no other monomers were found, even in trace amounts, it will be safe to assume that glucose and fructose were the only constituents of the reducing sugars. The ratio of glucose to fructose was about 1.22:1 in the Khalal stage which decreased to about 1:1 in the Tamar stage. Since fructose is much sweeter than glucose, its relative abundance can be of significant interest in imparting sweetness to dates at various stages of development. Most of the reports in the literature are, however, limited to the analysis of total and reducing sugars and sucrose content and their ratios at maturity. Studies on the change of sugar monomers during the various stages of development of date-fruit are scarce in literature. Recently, Sawaya et al (18) reported a glucose to fructose ratio of 1.5:1 in the early stage of development (Kimri) of two Saudi soft-date varieties, Khudari and Sullaj, which changed to 1:1 in the Tamar stage. These findings are similar to those reported here. In the semi-dry Deglet Noor variety from U.S.A., Coggins and Knapp (3) found an equal concentration of glucose and fructose in the early stages of development which became unequal in the later stages of maturity. Likewise, in the Egyptian dry variety 'Balady', Salem and Hegazi (17) reported an unequal ratio of glucose to fructose at

the Tamar stage. Evidently, these results suggest the possibility that glucose and fructose might exist in an equal proportion in the ripe soft-date varieties but might exist in unequal amounts in the ripe stage in the semi-dry and dry varieties. Since data in the literature is scarce regarding the relative abundance of glucose and fructose at the various stage of date-fruit development, further studies are needed to fully understand the phenomenon of the inter-conversion of sugar monomers in various date types.

The concentrations of tannins, vitamin C and ß-carotene are also given in Tables 1, 2, 3 and 4. The tannins, vitamin C and ß-carotene contents were all higher in the Khalal stage in all the varieties investigated and then decreased to lower levels in the Tamar stage.

The concentration of tannins ranged between 1.2-6.7% in the Khalal stage and 0.6-3.2% in the Tamar stage. These values are comparable with those reported (20) for the Deglet Noor dates and for different varieties (3, 14).

Vitamin C contents varied between 1.8-14.3 mg in the Khalal stage with an average of 6.5 mg and 1.1-6.1 mg in the Tamar stage with an average of 2.7 mg/100 g fresh pulp. The maximum amount of vitamin C detected at the Khalal stage was 14.3 mg in Woseili variety (Table 2) and 6.1 mg/100 g pulp at the Tamar stage in Khsab variety (Table 2), both of which were obtained from the Eastern Region.

The concentration of ß-carotene (provitamin A), when expressed in International Units (I.U) of vitamin A, ranged between 20-1416 I.U. in the Khalal stage and 0-259 I.U./100 g of flesh in the Tamar stage. The average values for all the varieties were 376 I.U. in the Khalal stage and 31 I.U. in the Tamar stage. These results are similar to those reported in the literature (24) and suggest that dates are not a rich source of vitamin A when compared to some other dried fruits such as apricots or prunes, although at the Khalal stage they contain a fair amount of this vitamin.

In conclusion, the contents of total and reducing sugars of all the varieties investigated were higher at the Tamar stage than the Khalal stage. On the other hand, the sucrose content was lower at the Tamar stage in comparison to the Khalal stage. Only two varieties, Sukkarat Al Shark and

Sukkari, were found to contain more sucrose than reducing sugars in the Tamar stage. These two varieties can be regarded to belong to the group of semi-dry/dry dates where sucrose is generally the predominant sugar in the ripe stage. The remaining varieties in Saudi Arabia are of the soft type which are characterized by the dominance of reducing sugars, which consist of only glucose and fructose in an unequal proportion in the Khalal stage which becomes equal in the Tamar stage. The data also provided useful information especially with respect to the sugar content, the potential utilization of the different varieties in product development and/or other foods such as jams, jellies, liquid sugar, candies and confectionaries in addition to being a base-line data for the date industry and international trade.

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Table 1

Sugars, tannins and Vitamin analysis of the major date varieties in Central and Northern Region (Gassim, Al-Kharj, Hail), Kingdom of Saudi Arabia (g/100g dry wt.).

Area	Variety	Total Sugars		Reducing Sugars		Sucrose		Glucose*		Fructose*		Tannins		Vit. C** (mg)		Vit. A** (I. U.)	
		K	T	K	T	K	T	K	T	K	T	K	T	K	T	K	T
Gassim	Maktumi	65	75	37	75	28	0	53	50	47	50	2.7	1.8	7.9	1.6	336	33
Gassim	Shakra	58	75	32	75	26	0	56	50	44	50	3.2	1.2	4.6	1.5	257	0
Gassim	Lahmia	68	77	67	77	1	0	53	50	47	50	1.2	1.3	5.6	2.3	505	0
Gassim	Sukkari	75	67	35	29	40	38	50	54	50	46	3.2	1.2	5.9	2.9	312	80
Cassim	Hulwa	60	77	39	77	21	0	51	50	49	50	2.5	1.5	1.8	2.6	149	65
Al-Kharj	Nabbut Al-Seif	67	79	53	79	14	0	51	50	49	50	2.2	1.2	6.9	1.9	392	33
Al-Kharj	Mukai	58	76	43	76	15	0	53	50	47	50	3.0	0.9	6.4	2.2	159	0
Al-Kharj	Sukai	70	79	62	79	8	0	52	50	48	50	4.5	1.2	7.6	2.4	122	0
Al-Kharj	Khudari	67	76	54	76	13	0	51	50	49	50	2.7	0.6	2.9	2.3	153	65
Al-Kharj	Khashram	70	79	65	79	5	0	51	50	49	50	3.2	0.9	3.3	2.3	394	43
Hail	Hulwa Hail	70	77	60	77	10	0	61	52	39	48	2.4	1.2	5.4	1.5	232	0
Hail	Duklat Khalaf	53	83	40	83	13	0	52	50	48	50	2.4	1.3	3.6	2.7	772	0
Hail	Rakhimi	78	78	53	77	25	1	54	49	46	51	3.7	1.6	5.9	3.8	647	0
Hail	Suwairi	69	78	49	78	20	0	52	49	48	51	4.7	1.0	6.7	2.9	508	0
Hail	Fankha	79	79	41	79	38	0	52	49	48	51	3.7	1.0	5.0	1.2	318	0

* Glucose & fructose expressed as percent of reducing sugars

** per 100 g fresh pulp

*** K is the Khalal stage and T is the Tamar stage in this and the following tables.

Table 2

Sugars, tannins and vitamin analysis of the major date varieties in the Eastern Region (Hofuf and Qatif), Kingdom of Saudi Arabia (g/100 g dry wt.).

Area	Variety	Total Sugars		Reducing Sugars		Sucrose		Glucose*		Fructose*		Tannins		Vit. C** (mg)		Vit. A** (I. U.)	
		K	T	K	T	K	T	K	T	K	T	K	T	K	T	K	T
Hofuf	Khlas	61	83	52	81	9	2	54	51	46	49	2.2	1.4	7.8	2.9	232	0
Hofuf	Hatmi	70	76	50	75	20	1	52	50	48	50	3.0	0.8	7.0	2.4	198	0
Hofuf	Khuneizi Hofuf	69	76	62	73	7	3	51	50	49	50	1.8	1.2	8.1	1.8	600	0
Hofuf	Ghurra	76	77	73	75	3	2	54	50	46	50	1.6	1.1	10.7	1.5	834	0
Hofuf	Shbibi	63	82	40	78	23	4	53	51	47	49	2.7	1.5	9.5	2.3	161	0
Hofuf	Shishi	70	76	56	76	14	0	56	50	44	50	1.7	1.0	10.3	3.8	398	0
Hofuf	Shahl	57	71	45	71	12	0	54	50	46	50	4.3	1.1	6.7	1.2	140	0
Hofuf	Ruzeiz	67	73	42	73	25	0	50	50	50	50	2.2	0.7	7.9	1.1	82	0
Hofuf	Woseili	56	75	35	75	21	0	53	51	47	49	1.5	1.0	14.3	2.9	233	0
Qatif	Khsab	53	65	52	65	1	0	54	50	46	50	5.2	3.2	3.7	6.1	-	0
Qatif	Khuneizi Qatif	75	74	62	74	13	0	55	51	45	49	2.6	1.3	5.9	2.0	192	47
Qatif	Uwaymat	66	71	56	71	10	0	50	51	50	49	3.6	1.2	4.0	1.5	155	0
Qatif	Hallaw	88	72	74	71	14	1	51	50	49	50	3.5	1.7	3.9	2.0	264	50
Qatif	Bukeira	67	76	51	68	16	8	49	50	51	50	3.9	1.1	5.0	2.2	901	0
Qatif	Abu Hallaw	81	66	68	66	13	0	49	50	51	50	3.4	1.3	6.3	2.7	232	0

* Glucose & fructose expressed as percent of reducing sugars

** per 100 g fresh pulp

Table 3

Sugars, tannis and vitamin analysis of the major date varieties in the Western Region (Al-Madina), Kingdom of Saudi Arabia (g/100 g dry wt.).

Area	Variety	Total Sugars		Reducing Sugars		Sucrose		Glucose*		Fructose*		Tannins		Vit. C** (mg)		Vit. A** (I. U.)	
		K	T	K	T	K	T	K	T	K	T	K	T	K	T	K	T
Al-Madina	Rabia	78	80	8	80	70	0	53	50	47	50	6.3	1.9	5.4	2.0	472	259
Al-Madina	Ajwa	77	77	64	77	13	0	55	50	45	50	5.7	1.1	8.3	2.9	559	92
Al-Madina	Barni	54	75	44	75	10	0	53	51	47	49	3.9	1.2	6.3	3.0	247	67
Al-Madina	Shalabi	66	79	31	78	35	1	50	50	50	50	5.2	1.8	7.6	3.9	60	38
Al-Madina	Safawi	58	79	37	78	21	1	55	50	45	50	3.9	1.2	7.3	3.3	355	0
Al-Madina	Ruthana	61	-	18	-	43	-	53	-	47	-	2.6	-	8.4	-	135	0
Al-Madina	Hulwa	60	87	31	85	29	2	55	50	45	50	6.7	1.9	4.7	2.7	326	0
Al-Madina	Barhi	-	76	-	76	-	0	-	50	-	50	-	1.0	-	3.0	-	0
Al-Madina	Sukkarat Al Shark	53	81	24	38	29	43	43	52	57	48	4.1	2.2	5.6	3.0	69	20
Al-Madina	Anbara	41	75	35	73	6	2	58	51	42	49	4.0	1.3	5.4	2.0	59	83
Al-Madina	Baid	69	74	28	72	41	2	57	50	43	50	2.9	1.4	8.5	3.7	20	0
Al-Madina	Sukkarat Yanbu	65	-	45	-	20	-	52	-	48	-	3.0	-	7.3	-	277	0

* Glucose & fructose expressed as percent of reducing sugars

** per 100 g fresh pulp

Table 4

Sugars, tannins and vitamin analysis of the major date varieties, Southwestern Region (Wadi Khelis & Fatmah, Tarabah and Bisha), Kingdom of Saudi Arabia (g/100 g dry wt.).

Area	Variety	Total Sugars		Reducing Sugars		Sucrose		Glucose*		Fructose*		Tannins		Vit. C** (mg)		Vit. A** (I. U.)	
		K	T	K	T	K	T	K	T	K	T	K	T	K	T	K	T
Wadi Khleis & Fatmah	Mutablabha	74	78	59	78	15	0	51	50	49	50	4.6	2.2	6.5	3.4	244	25
Fatmah	Luban	71	79	62	68	9	11	52	51	48	49	4.4	2.0	5.8	5.3	734	50
Fatmah	Mushwek	79	79	60	79	19	0	55	50	45	50	4.8	2.0	5.4	2.9	235	0
Fatmah	Sifri Khleis	71	81	70	81	1	0	54	50	46	50	4.5	2.2	6.7	5.6	1416	83
Tarabah	Sifri Tarabah	71	82	35	81	36	1	53	50	47	50	3.9	1.9	5.6	3.4	682	133
Tarabah	Sari	65	78	61	77	4	1	53	50	47	50	5.2	1.1	6.4	1.5	144	0
Tarabah	Magfizi	82	71	81	71	1	0	54	50	46	50	2.8	1.0	6.8	2.6	215	0
Bisha	Shukal	72	83	44	82	28	1	-	50	-	50	4.4	1.3	6.2	3.9	637	81
Bisha	Barni	74	81	60	79	14	2	53	50	47	50	5.8	1.8	8.1	3.5	92	82
Bisha	Hamar Amik	67	80	63	80	4	0	-	50	-	50	4.3	1.2	11.4	2.4	605	0
Bisha	Jasap	74	75	57	74	17	1	52	49	48	51	4.5	2.1	7.0	3.8	1067	0
Bisha	Sifri Bisha	76	82	60	80	16	2	53	50	47	50	3.7	1.4	5.6	2.5	399	0
Bisha	Lahak	78	80	74	80	4	0	55	51	45	49	6.6	2.7	6.0	4.0	661	132

* Glucose & fructose expressed as percent of reducing sugars

** per 100 g fresh pulp

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STUDIES ON THE POLLEN AND FLOWERS OF FIVE MALE CULTIVARS OF IRAQI DATE PALM
(Phoenix dactylifera L.)

1. PROXIMATE COMPOSITION WITH SPECIAL REFERENCE TO SOME LIPID CONSTITUENTS AND MINERALS

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ABSTRACT

Chemical analyses were carried out of pollen and flowers of Ghannami Ahmar, Ghannami Akhdar, Ghulami, Aadie and Khikri Wardi male date palm cultivars to determine ash, moisture, protein, total fiber, lipids, total sugar, reducing and non-reducing sugars. Pollen of Ghannami Ahmar, Ghannami Akhdar, Aadie, Khikri Wardi were saponified and the saponifiable and non-saponifiable lipids varied from 3.00 to 6.50% and 3.34 to 6.60% respectively. Total lipid contents were 9.68 – 11.80%. Non-saponifiable lipid fractions isolated from date palm pollens contained 1.1 – 1.2% hydrocarbons; 0.87 – 2.87% sterol like compouds and 0.86 – 1.03% polar compounds. The major inorganic elements K, Na, Ca, Mg and trace elements Cu, Fe, Mn, Zn were determined by atomic absorption spectrophotometry and flame emission photometry. The flowers of all varieties had a higher contents of ash, crude fiber and total lipids and lower contents of total sugar, reducing and non-reducing sugars than the pollens.

دراسة لحبوب لقاح وازهار خمسة اصناف من نخيل التمور العراقية
١ . التحليل الكيمياوي

ف . ث بوخايف، ف .ص . زكي، ج .ش . توما ول .م . علي
قسم النخيل والتمور / مركز البحوث الزراعية والموارد المائية، الفضيلية،
بغداد ـ العراق

الخلاصة

شملت هذه الدراسة التحليل الكيميائي لكل من ازهار وحبوب لقاح خمسة اصناف من نخيل التمر (غنامي احمر، غنامي اخضر، غلامي، عادي، خكري وردي) لتقدير الرماد، الرطوبة، البروتينات، مجموع الالياف، الدهون والسكريات الكلية (المختزلة والغير مختزلة).

تم صوبنة اربعة اصناف من حبوب اللقاح (غنامي احمر، غنامي اخضر، عادي خكري وردي) واتضح ان نسبة الدهون المصوبنة تتراوح ما بين 3.00 – 6.50 % ونسبة الدهون غير المصوبنة تتراوح ما بين 3.34 – 6.60 % وتراوحت نسبة الدهون المصوبنة الكلية ما بين 9.68 – 11.80٪ تم تحليل اجزاء الدهون غير المصوبنة المفصولة من حبوب اللقاح لتقدير الكربوهيدرات، الستيرولات والمركبات القطبية فيها وكان محتواها 1.1 – 1.2% هيدروكاربونات و 0.87 – 2.87% مركبات شبيهة بالستيرولات و 0.86 – 1.03 % مركبات قطبية. تم تقدير العناصر الرئيسية البوتاسيوم، الصوديوم، الكالسيوم، المغنيسيوم، والعناصر النادرة (النحاس، الحديد المنغنيز، الخارصين بواسطة الطيف الضوئي.

اتضح ان ازهار جميع الاصناف تحتوي على أعلى مستوى من الرماد والالياف الخام والدهون الكلية وأوطأ مستوى من السكريات الكلية (السكريات المختزلة وغير المختزلة) من حبوب اللقاح.

INTRODUCTION

This work was carried out as part of a wider study to determine the

chemical constituents of pollen and flowers of the date palm *Phoenix dactylifera L.*, and to find any possible application in medicine, pharmacology, agriculture or food industry.

During our investigations on pollen chemistry we noticed, that some fractions of saponifiable and non-saponifiable lipids attracted some kinds of insects. For this reason it was thought, that a chemical investigation into the composition of the pollen is important. Observed differences in the chemistry of pollens from different male cultivars may also furnish plant breeders with information of value. Considerable claims have been made from very early times of the nutritive value of pollen in human diets (1,7), while inhaled pollen is known to be detrimental to the health of some people (9), hence pollen chemistry is also of interest on these grounds. Some researchers showed that pollen protein extracts can serve as biostimulants in feeding rations (17). Plant growth substances have been detected in the pollen of apple (6), pine, corn (4), etc. Pollen from date palm, *Phoenix dactylifera L.* and cattail *Typha elephantia,* are reported to be used directly for human consumption. Pollen candy a mixture of pollen with honey or molasses and chocolate, is occasionally sold in health food stores in the United States (15).

One of the earliest chemical analyses of date palm pollen reported by (16). Hassan et al found a non-crystalline oestrogenic substance in ether extracts of date pollen (5). Al-Ridi also determined rutin content in date pollen and isolated a crude gonadotrophically active substance from the pollen, which was found to be toxic when injected into rats (11, 12). Benett (3) isolated estrone and cholesterol from date palm pollen in U.S.A. Preliminary screening of date pollen found some sterols and flavonoids, such as B-amirin, B-sitosterol, rutin and quercitin, triterpenes and saponins (8).

The work presently reported represents the first study of the chemistry of pollen of Iraqi date varieties.

MATERIALS AND METHODS

A. *Materials*

The flowers of mature, but unopened spathes of five different male cul-

tivars – Ghannami Akhdar, Ghannami Ahmar, Aadie, Khikri Wardi and Ghulami were obtained from Zaafarania Horticultural Experimental Station, Baghdad during the month of April 1978 and April 1979. The pollen grains of these five varieties were collected by shaking the detached male flowers carefully on sieves. Samples of the fresh pollen were used for determination of moisture and sugar contents. For other analyses the pollen was allowed to dry while enclosed in the anthers at room temperature (24 – 30°C) for about two to three weeks. The flowers were regularly turned over during drying period to avoid lumping and spoilage. When flowers turned brown the pollen was extracted by sieving. The separated pollen and flower samples were dried at room temperature to constant weight and were placed in simple stoppered glass tubes and kept in the refrigerator until analysed. All solvent systems used were redistilled over metallic sodium.

B. *Methods*

I. *AOAC Methods:* The official methods of analysis of the Association of Official Agricultural Chemists (2) were used. They included the determination of ash, moisture, protein, total fiber, total lipids, reducing and non-reducing sugars.

II. *Mineral Content:* A flame emission photometer and an atomic absorption spectrophotometer (Perkin Elmer Model 305) were employed to determine contents of major elements, such as K, Na, Ca and Mg as well as some trace elements, such as Cu, Fe, Mn and Zn.

Sulphur and phosphorus contents were also determined by the methods described (10).

III. *Properties of some lipids:* Pollens were saponified for $5\frac{1}{2}$ hours at 60°C under nitrogen with ethanolic potassium hydroxide (1 part pollen, 10 parts 50% ethanol, 1.3 parts potassium hydroxide). The reaction mixture was allowed to cool and were then filtered. The residues of pollen were rinsed several times with hot ethanol and the last was added to the filtrates.

Most of the ethanol from the filtrates was evaporated under vacuum and the non-saponifiable fraction was extracted by shaking twice with double

volumes of diethyl ether and then with double volumes of peroxide-free diethyl and n-hexane (4:1) and with diethyl ether and n-hexane (3:2) according to the method (14). The aqueous phase was acidified to pH 1, with diluted hydrochloric acid and the saponifiable fraction was extracted twice each with double volumes of diethyl ether and n-hexane. The lipid extracts were washed with distilled water until they were neutral, dried over anhydrous sodium sulphate, filtered, and the solvent system was evaporated under vacuum to near dryness. The residues were further dried under a stream of nitrogen before weighing.

The non-saponifiable matter was fractionated on silicagel column as below.

Above 100 mg sample of the non-saponifiable fraction of lipid material was dissolved in 10 – 15 ml of n-hexane and chromatographed on 1.5 × 7.5 cm column of silica gel (Merk; 0.63 – 0.200 mm). The hydrocarbons were eluted with n-hexane. The sterol – like compounds were eluted with diethyl ether, and the more polar compounds than 3-p sterols were eluated with methanol. The eluates were sampled and monitored by TLC.

Hydrocarbons (Rf = 1.0 in system hexane diethyl ether 9:1).

Free sterols (Rf – 0.35 in system heptane-methylethyl ketone – acetic acid 43: 7:1). They gave a red colouration when sprayed with 50% H_2SO_4 followed by heating. Elution of the columns with methanol was continued until the methanol fractions when evaporated to dryness were shown not to leave any residue. The amount of each class was determined gravimetrically.

RESULTS AND DISCUSSION

The results on the general composition and mineral contents of flowers and pollen are presented in (Tables 1-5). All figures represent the average of at least two replicates.

Moisture content of date pollen of different varieties was high and generally ranged between 49.21% of Ghannami Ahmar to 56.26% of Khikri Wardi. The relatively high moisture contents are probably, because the pollen were taken from closed spadixes. Our data, are very close similar to

those reported (13).

Ash contents of both pollen and flowers are generally high, when compared to those of other tissues reported previously. Flowers have a higher ash content than pollen while there is no marked difference between varieties. Pollen's ash content ranged from 5.77% for Khikri Wardi to 5.36% for Ghulami. However, the flower's ash content ranged from 7.65% to 6.34% for the same two varieties respectively. The results of mineral analyses of pollen and flowers are presented in tables 3 and 4. Macro elements (K, Na, Ca, Mg, P, S) and trace elements (Cu, Fe, Mn, Zn) were determined. The ranges obtained were 1.13 – 1.54% for K, 1.09 – 1.13% for Ca, 0.22 to 0.27% for Mg and from 0.53 to 0.73% for P. These figures are close to those reported (16), namely 1.14%, 1.18%, 0.38% and 0.71% for the above elements respectively.

Crude fiber contents (Table 1) in pollen ranged from 8.74% for Khikri Wardi to 10.75% for Aadie. In flowers the range was from 18.11% for Aadie to 28.09% for Ghannami Ahmar (Table 2). The flowers have a higher percentage of crude fiber than their pollen. Protein contents (Table 1) were determined only for pollen and they ranged from 23.72% for Khikri Wardi to 29.72% for Aadie. Our results are close to the results (13). Total sugar contents in pollen ranged from 14.68% for Ghannami Akhdar (which has also the lowest quantity of reducing sugar at 0.52%, to 20.8% for Ghulami, (which also has the highest percentage of reducing sugar at 3.37%). Contents of total sugar ranged from 14.68% to 20.81% for pollen and 5.35 to 6.50% for flowers, non-reducing sugar ranged from 13.23 to 16.97% for pollen and 3.56 – 4.43% for flowers. In both fractions, the contents were much higher in pollen than in the flowers.

The results on the total lipids of pollen of these varieties are present in the Table1 and 5. Results obtained by ether extraction of pollens of different varieties as total lipids are presented in Table 1. The percentages of total lipids of the pollen, in this case calculated by adding values obtained for saponifiable and non-saponifiable lipid fractions, are shown in Table 5. (second method). The values for lipid content obtained by ether extraction of pollen are somewhat higher than those obtained by adding percentage

contents saponifiable and non-saponifiable fractions. It seems probable that some percentage of lipids was lost during fractionation procedures.

Total lipids (ether extracts) of flowers yielded higher values than for pollen. Between varieties Ghannami Ahmar has the lowest content of total lipids (10.96% for pollen and 14.26% for flowers).

Flowers and pollen of Ghulami have highest contents of total lipids (12.95% for pollen and 15.94% for flowers).

Table 5 gives values obtained by separating the saponifiable and non-saponifiable lipids of the pollen of the 4 varieties. Ghannami Ahmar has lowest content of saponifiable lipids (3.0%) and highest content of non-saponifiable lipids (6.68%). Khikri Wardi has highest content (6.50%) of saponifiable lipids and lowest contents 3.34% of non-saponifiable lipids.

Table 5 further shows that there is some similarity of the hydrocarbon content value of pollen for the four cultivars Ghannami Ahmar has highest content of sterol compounds (2.87%) and Khikri Wardi has the lowest content of these compounds (0.87%). While Ghannami Ahmar has the highest content of polar compounds (1.03%) and Aadie has the lowest content of polar compounds (0.86%).

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Table 1

Proximate composition of pollen of different male date palm cultivars based on dry weight

Male Cultivars	Moisture	% dry wt.						
		Ash	Crude fiber	Crude Protein	Total sugar	Reducing sugar	Non-reducing sugar	Total lipids
Ghannami Akhdar	50.46	5.58	10.66	28.62	14.68	0.52	13.44	12.89
Ghannami Ahmar	49.21	5.43	10.32	27.13	16.71	2.78	13.23	10.96
Aadie	45.15	5.38	10.75	29.72	17.58	1.29	15.47	12.60
Ghulami	53.20	5.36	09.05	27.00	20.81	3.37	16.56	12.95
Khikri Wardi	56.26	5.77	8.74	23.72	20.68	2.82	16.97	11.64

Total sugar (%) – reducing sugar (%) = Non reducing sugar (%) × 0.95.

Table 2

Ash, crude fiber, sugars and lipid content (based on dry weight) of flowers from five different cultivars of male date palm in Iraq

Male Cultivars	% dry wt.					
	Ash	Crude fiber	Total* sugar	Reducing sugar	Non-reducing sugar	Total lipids
Ghannami Akhdar	6.90	22.65	6.08	2.31	3.58	14.51
Ghannami Ahmar	6.50	28.09	5.83	1.36	4.25	14.26
Aadie	7.20	18.11	5.35	1.60	3.56	14.92
Ghulami	6.34	25.66	6.50	1.84	4.43	15.94
Khikri Wardi	7.65	22.31	5.90	2.14	3.57	15.01

★ Total sugar was determined after converting to reducing sugars and according to the following formula (AOAC,1975) (2).
Total sugar (%) − reducing sugar (%) = non-reducing sugar (%) × 0.95

Table 3

Mineral content of the pollen of different male date palm cultivars

Male Cultivars	% dry wt. Major and Trace elements									
	K	Na	Ca	Mg	P	S	Cu	Fe	Mn	Zn
Ghannami Akhdar	1.54	0.37	1.13	0.27	0.53	0.037	0.003	0.08	0.008	0.021
Ghannami Ahmar	1.22	0.75	1.09	0.23	0.62	0.036	0.003	0.09	0.009	0.014
Aadie	1.13	0.23	1.11	0.22	0.73	0.039	0.004	0.08	0.006	0.013
Khukri Wardi	1.13	0.22	1.12	0.22	0.73	0.034	0.002	0.08	0.005	0.012

Table 4

Mineral content of the flowers of different male date palm cultivars

Male Cultivars	%dry wt. Major and Trace elements								
	K	Na	Ca	Mg	S	Cu	Fe	Mn	Zn
Ghannami Akhdar	2.62	0.057	1.16	0.16	0.057	Nil	0.07	trace	0.008
Ghannami Ahmar	2.63	0.059	1.14	0.17	0.037	Nil	0.08	trace	0.009
Aadei	3.96	0.066	1.26	0.19	0.030	Nil	0.09	trace	0.007
Ghulami	2.74	0.067	1.29	0.22	0.027	Nil	0.06	trace	0.01
Khukri Wardi	3.25	0.053	1.18	0.19	0.032	Nil	0.07	trace	0.008

Table 5

Percentage of some lipid constituents in pollen of different male date palm cultivars

Male Cultivars	% dry wt.					
	Total* lipids	Saponifiable matter	Non-saponifiable matter	Hydro-carbons	Sterol like comp.	Polar comp.
Ghannami Akhdar	11.80	5.60	6.20	1.20	2.1	0.96
Ghannami Ahmar	9.68	3.00	6.68	1.10	2.87	1.03
Aadie	10.40	6.00	4.40	1.15	1.37	0.86
Khikri Wardi	9.84	6.50	3.34	1.10	0.87	0.89

★ Reported are summarising of saponifiable & non-saponifiable matters.

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TANNIN CONTENT OF MAIN PARTS OF DATE PALM
(Phoenix dactylifera L.)

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ABSTRACT

The study was carried out to determine spectrophotometrically tannin content in the main parts of Zahdi date palm (*Phoenix dactylifera* L.). It was found that gallotannin ranged from 0.43 to 2.78% and ellagitannin from o to 0.99%. The condensed tannins ranged from 0.75 to 4.48% in different main parts of the date palm. There was a definite effect of time of extraction on ratio of cyanidin to delphinidin in condensed tannins.

محتوى التانين في الاجزاء الرئيسية لنخلة التمر
Phoenix dactylifera L.

ع . م . م . نظام الدين ، ف . ث . بوخايف و ل . م . علي .

قسم النخيل والتمور ، مركز البحوث الزراعية والموارد المائية

الفضيلية ، بغداد ـ العراق

الخلاصة

تناولت هذه الدراسة تقدير محتوى التانين بواسطة السبكتروفوتوميتر (جهاز

الطيف) في الأجزاء الرئيسية لنخيل التمر صنف الزهدي. لقد وجد ان الكالوتانين يتراوح ما بين 0.43 – 2.78 ٪ الايلاجيتانين يتراوح ما بين 0 – 0.99%. اما التانينات المكثفة فتتراوح ما بين 0.75 – 4.48% في الاجزاء المختلفة الرئيسية لنخيل التمر. كان هناك تأثيراً واضحاً لزمن الاستخلاص على نسبة السياندين / دلفندين في التانينات المكثفة.

INTRODUCTION:

The term "Tannins" was reserved for those phenolic compounds of sufficiently high molecular weight (more than 500) to form strong complex with proteins and other polymers. Tannins have certain biological and chemical effects on plants. They play vital role in protecting plants from insects. The resistant in plants come from a relatively high contents of condensed tannins (8). It is believed but not proven, that they contribute to plant protection by providing resistance against consumption by birds (10) and attack by insects and microorganisms (1,12). Condensed tannin isolated from flower buds of cotton (*Gossypium hirsutum* L.) retards larval growth of the tobacco budworm *(Heliothis virescens* F.) when added to artificial diets (13).

The tannins in plant consist of soluble and condensed tannins. The former contain gallo-and/or ellagitannin, which have important effect on the taste of fruits before ripening (16). Bate-Smith (4) reported that gallic acid from gallotannin can diffuse on to the surface of the leaf and act as an inhibitor of germination of fungal spores. The second is the polymeric flavin, which has considerable agricultural importance, in preventing bloat and in protecting dietary protein against microbiol deamination in rumen. Both actions have been attributed to the ability of condensed tannin, to form insoluble complexes with leaf and salivary proteins at rumen pH values as studied (11), whereas at intestinal pH the complexes were dissociated and on the other hand tannins have good technical application in industry, such as traditional use in leather manufacture (7) . Date palm constitutes a big source of probable raw material which goes as waste. This could be successfully used as a source for valuable chemical components

such as flavonoids,tannins, waxes, etc. Some studies were carried out on the date palm parts and they have shown their possible utilization (6), by studying the pigment contents of leaflets (15). It was found that green and dry leaflets of Zahdi variety contain high quantity of anthocyanin and anthocynidin, as anthocyanidin indicated high content of condensed tannin. The present study was carried out on the main parts of date palm (green and dry leaflets, frond bases, date palm fiber and spadix fruit stalks) of Zahdi variety to find their soluble and condensed tannins content, since literature survey indicates that it has not been attempted in the past.

MATERIALS AND METHODS

Preparation of raw material:

Green and dry leaflets, frond bases, fiber and spadix fruit stalks of Zahdi variety of date palm were collected from Aziziya Horticultural Experimental Station of the Agriculture and Water Resources Research Center (SRC). The green leaflets were taken from 5 years and dry leaflets were taken from 7 years old trees. Every sample was powdered to pass through 1mm screen.

Determination of tannins

Anthocyanidin and ellagitannin were determined according to Bate-Smith (4)..

Preparation of extract: One gram of the ground sample was extracted three times with 100m1 of 50% boiling methanol and the extract filtered through fiber glass.

Condensed tannins: Determination of anthocyanidin and ellagitannin

Extract (0.5m1.) was heated for 2 hours at 95°C with 4ml. of 5% HCL in n-butanol. The visible spectrum was recorded and maximum absorptivity measured at the peak, which lay between 547 and 558nm. depending on the relative amounts of cyanidin and delphinidin present. Results were recorded as $E^{1\%}_{1cm}$ of the samples. Anthocyanidin content in powder were determined in the same way after 1 and 3 hours time intervals.

Soluble tannin: Determination of Ellagitannin

0.5 ml extract was measured in a 1cm. dia. test tube drown into a capillary. 1.5 ml. of 50% aqueous methanol and 0.16ml of 6% aqueous

acetic acid were added, the temperature was adjusted to 25-30°C and nitrogen was bubbled through for 15min; 0.16ml of 6% aqueous $NaNO_2$ was then added. Nitrogen was passed for a further 0.25min. and the capillary was sealed off, spectrophotometric measurements were done immediately. The blue colour reaction (600nm) and a yellow colour reaction (400-430nm) developed slowly. At 30°C the blue reaction reached a maximum in 30-40 min. and the absorptivity at this time was used for calculation of hexahydroxydiphenil glucose ($E^{1\%}_{1cm}$ = 51.5). The blue colour fades to 0 after 24 hours.

Determination of Gallotannin: It was done using the method of Haslam outlined below (3). The aqueous acetone extract of the samples were treated with KIO_3 at O°C and the absorption of the red colour produced was measured at 550nm. The maximum colour was reached in short time (40 min) and acetone in final extract was 20% under these conditions the $E^{1\%}_{1cm}$ at 550nm for standard gallotannin was 20 (4).

The low molecular weight flavans were separated and determined in ethylacetate extract as described by Zofia, et al., (18).

Water and ethylacetate extracts: The powder of sample was extracted with 70% acetone containing 0.1% ascorbic acid. NaCl was added to extract until an upper phase (acetone) was separated from the lower phase (water). The acetone evaporated at 30°C under vacuum to yield an aqueous residue which was diluted with an equal volume of water and extracted with chloroform and ethylacetate sequentially. The aqueous solution contains the polymeric proanthocyanidin.

The flavan was estimated by vanillin-HCl method (5). Present study confirms that the absorbance at 500nm. For 100mg of low molecular weight flavan (ethyl acetate fraction) is 0.55.

RESULTS AND DISCUSSION.

Soluble tannin.

The results of analysis of the main parts of Zahdi variety in Table 1 indicate, that the percentage of gallotannin were 2.780, 0.832, 0.581, 0.432 and 0.748 respectively. Gallotannin was determined as galloyl ester (3,4).

This method consisted in treating the ester or the aqueous acetone (70%) extract of leaflets with KIO_3 at O°C. Ellagitannin determined as ester of hexahydroxydiphenylglucose (HHDPG) in aqueous methanolic extract of sample were 0.99, 0.98, 0.30, 0.00 and 0.27 % for green leaflets, dry leaflets, frond bases, fiber and spadix fruit stalks. From the results it was shown that green leaflets contain the maximum quantity of gallo-and ellagitannin and the date palm fiber the lowest quantity. Some studies were done on dates which could confirm the lower soluble tannin content of dry leaflets as compared with green leaflets. Soluble tannins are decreased during ripening of fruits from 0.5% in green Hallawy variety to 7.3% in Egyption Amhat dates as reported (16) and these quantities of soluble tannins decreased by maturation to dry dates.

Condensed tannin.

Mair and Metzler (14) studied the soluble and insoluble leucoanthocyanidin tannin in Deglet Noor date and found that soluble leucoanthocyanidin tannin increased during growth and are converted to insoluble leucoanthocyanidin during maturation. It appears from results that date palm parts contain leucoanthocyanin producing cyanidin and delphinidin when heated with mineral acid. The leucoanthocyanin has two types of anthocyanidin; the first is leucoanthocyanidin and the second is proanthocyanidin. The leucoanthocyanidin formed from flavan-3,4-diol and the proanthocyanidin formed from catechin (flavin-3-ol) and the condensation of flavan produced condensed tannin. All above compounds anthocyanidin (cyanidin, delphinidin and/or others) were determined by heating butanol-HCl with sample to 95°C.

Bate-Smith (2) indicated that 2 hours are used for studying value of anthocyanidin production contrary to our results which show that 3 hours are more suitable, since there is more delphinidin produced after 3 hours as shown in table 3 by comparison between the ratios of cyanidin to delphinidin. Bate-Smith illustrated that λ max can be used to calculate the cyanidin: delphinidin ratio as shown in Table 3. Also it was reported that average procyanidin has an $E^{1\%}_{1cm}$ of 150 and prodelphinidin 300. These values can be used to calculate the percentage of condensed tannin by using the $E^{1\%}_{1cm}$ of sample after multiplying it by 100 and dividing it with theoretical $E^{1\%}_{1cm}$ of every sample. The results indicate three

hours are more suitable for the determination of condensed tannin. The date palm leaflets contain valuable quantities of both anthocyanin and anthocyanidin as reported (15). Since the condensed tannin depends on the production of cyanidin and delphinidin from leucoanthocyanin. From Table 6, it was shown that condensed tannins were 4.480, 3.525, 2.532, 1.110 and 0.757 percent respectively.

The low molecular weight flavan content

The low molecular weight tannins are separated in ethylacetate fraction and it can be seen from Table 7, that ethylacetate tannins are high in spadix fruit stalks and very low in fiber. The ethylacetate flavans are 0.413, 0.302, 0.118, 0.085 and 0.031 percent of spadix fruit stalks, dry leaflets, green leaflets, frond bases and fiber respectively. The increase in low molecular weight flavans of dry leaflets as compared with green leaflets may be due to some hydrolysis and degradation during drying.

The polymerization of tannin was measured by determination of ethylacetate tannin by vanillin-HCl method and dividing it by the value of the condensed tannin of powder. The degree of polymerization was very high in condensed tannin of date palm fiber and decreased gradually, in following order green leaflets, spadix fruit stalks, frond bases, and dry leaflets. Goldstein and Swain (8) found that the ratio of vanillin / leucoanthocyanin has been used to measure the degree of flavan polymerization and it was found that (% V/LA) ratio were 32, 41, 48, and 46 for apple, pear, banana, grape and persimmon when extracted with 50% methanol. The above results indicated the high degree of polymerization of condensed tannin in parts of date palm as compared with main fruits.

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Table 1

Soluble tannins of main parts of date palm (Zahdi cultivar).

Date palm parts	Gallotannin %	Ellagitannin** %
Green leaflets	2.780	0.990
Dry leaflets	0.832	0.980
Frond bases	0.581	0.300
Date palm fiber	0.432	0.000
Spadix fruit stalks	0.748	0.270

* Determined as galloylester

* Determined as hexahydroxydiphenylglucose (H H D P G).

Table 2

Effect of extraction on λ max.

Date Palm parts	Methanolic extract	Powder extracted for 1 hour .	Powder extracted for 3 hours.
Green leaflets	549	547	551
Dry leaflets	548	548	548
Frond bases	551	547	551
Datepalm fiber	551	547	552
Spadix fruit stalks	551	552	552

Table 3
The ratio of cyanidin to delphinidin

Date palm parts	Methanolic extract		Powder extracted for 1 hour		Powder extraced for 3 hours.	
	del.	cyan.	del.	cyan.	del.	cyan.
Green leaflets	20	80	00	100	40	60
Dry leaflets	10	90	00	100	10	90
Frond bases	40	60	00	100	40	60
Date palm fiber	40	60	00	100	40	60
Spadix fruit stalks	40	60	50	50	50	50

del = delphinidin; cyan. = cyanidin $E^{1\%}_{1cm}$

Table 4
Analytical results of methanolic extract* of main date palm parts

Date palm parts	Theoretical $E^{1\%}_{1cm}$ value	Practical $E^{1\%}_{1cm}$ value	Condensed tannin after removal of anthocyanin (%).
Green leaflets	180	3.020	1.500
Dry leaflets	165	2.590	1.270
Frond bases	210	0.821	0.390
Date palm fiber	210	0.215	0.150
Spadix fruit stalks	210	9.380	4.467

* The extraction with 50% methanol for 2 hours.

Table 5
Analytical results of powder sample boiled for one hour

Date Palm Parts	Theoretical $E^{1\%}_{1cm}$ value	Practical $E^{1\%}_{1cm}$ value	Cóndensed tannin after removal of anthocyanin. (%).
Green leaflets	150	4.312	2.694
Dry leaflets	150	3.752	2.201
Frond bases	150	1.40	0.670
Date palm fiber	150	1.970	1.280
Spadix fruit stalks	225	9.640	4.180

Table 6
Analytical results of powder sample boiled for 3 hours

Date palm parts	Theoretical $E^{1\%}_{1cm}$ value	Practical $E^{1\%}_{1cm}$ value	Condensed tannin after removal of* anthocyanin (%).
Green leaflets		7.780	3.525
Dry leaflets	165	4.248	2.532
Frond bases	210	1.780	0.757
Date palm fiber	210	2.500	1.110
Spadix fruit stalks	225	10.300	4.480

* Condensed tannin after removal of anthocyanin which was done by measuring the absorbance by using butanol-HCL without boiling.

Table 7

Flavan content of the main part of date palm.

Date palm parts	Ethylacetate fraction (tannin %)	Polymerization (% v / cy)*.
Green leaflets	0.1179	3.344
Dry leaflets	0.3018	11.919
Frond bases	0.0845	11.162
Date palm fiber	0.0305	1.110
Spadix fruit stalks	0.4130	9.218

* v— The measurement of flavan content of ethylacetate fraction by vanillin HCl method.

cy- The condesed tannin content determined by butanol-HCl method after 3 hours.

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EFFECT OF REDUCED ATMOSPHERIC PRESSURE WITH DIFFERENT TEMPERATURES ON *Ephestia cautella* WALKER (LEPIDOPTERA, PYRALIDAE), A PEST OF STORED DATES IN IRAQ*.

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ABSTRACT

Eggs, first and fourth instar larvae, pupae and adults of *Ephestia cautella* Walker were exposed to vacuum with temperatures of 35, 40, 45 or 50°C and 15-30% RH for different lengths of time to obtain estimates of the lethal times for 50%, 95% and actual 100% kill of the insect population. Eggs were more resistant to such treatments particularly at lower temperatures (35 and 40°C) while the adults were the most susceptible. The LT50, LT95 and LT100 for the eggs at 35 – 50°C were respectively 430-23, 1000-30 and 1090-40 minutes while for the adults were respectively, 14, 16 and 20 minutes. The larvae and pupae were little less susceptible than the adults. Females, pupae or adults, were more resistant to such treatments

* This paper was presented at the IX International Congress of Plant Protection, Washington, D.C., USA., 5-11 August, 1979.

than the males. When they were exposed to same temperature and times, their mortalities especially at lower temperatures were about half that of the males. Females, survived treatments, laid an average of 10.3 eggs with 31.2% hatching compared to 51.4 eggs with 72.5% hatching of eggs from females exposed to treatment of temperatures alone or 157.2 eggs with 83.6% hatching of eggs laid by the control females which lived under optimal temperature of 25°C. LT100 for any stage of *E. cautella* is much shorter under treatment with temperature and vacuum than under temperature alone. The application of such treatment to control insects of stored dates is discussed.

الخلاصة

عرض بيض ويرقات الدور الأول والرابع وعذارى وكاملات عثة التين *Ephestia cautella Walk.* الى التفريغ الهوائي مع درجات حرارة 35, 40, 45 أو 50 م و 15 - 30٪ رطوبة نسبية وذلك لفترات زمنية مختلفة للحصول على تقديرات للزمن القاتل 50٪، 95٪ والطول الزمني الحقيقي القاتل لـ 100٪ من سكان هذه الحشرة.

أوضحت النتائج أن البيض أكثر مقاومة لهذه المعاملات وخاصة في درجات الحرارة الواطئة (35 و 40 م) في حين كانت الكاملات أقلها مقاومة. فكانت تقديرات الـ LT100, LT95, LT50 للبيض في حرارة 35 - 50 م على التوالي كالآتي 430 - 23، 1000 - 30 و 1090 - 40 دقيقة، في حين كانت الكاملات على التوالي 14، 16 و 20 دقيقة. أما اليرقات والعذارى فان مقاومتها أكثر قليلاً من الكاملات.

وظهر أن الإناث (العذارى والكاملات) أكثر مقاومة من ذكورها. فحينما عرضت لنفس درجات الحرارة وفترات التعريض كانت نسب القتل بين الاناث وخاصة في الدرجات الواطئة يعادل نصف نسبة القتل بين الذكور.

وتبين أيضاً، أن الاناث التي استطاعت أن تعيش المعاملات وضعت بيضاً يعادل 10,3 بيضة للأنثى ونسبة فقسه 31,2٪في حين وضعت اناث المقارنة التي عاشت درجات حرارة المعاملات بدون التفريغ الهوائي ما يعادل 51,4 بيضة للأنثى ونسبة فقس 72,5٪بينما وضعت اناث المقارنة التي عاشت في حرارة مثلى قدرها 25 م ما معدله 157,2 بيضة للأنثى ونسبة فقس 83,6٪

وفي مقارنة بين تأثير اتحاد الحرارة والتفريغ الهوائي مع الحرارة فقط على حشرة عثة التين ظهر أن فترة القتل تحت المعاملة الأولى أقل بكثير منها تحت المعاملة الثانية.

وقد نوقش تطبيق هذه المعاملات في مكافحة حشرات التمور المخزونة.

INTRODUCTION

Light infestation of dates with the fig moth *Ephestia cautella* starts in orchards and increases in store houses, reaching up to 85% infestation among Zahdi date variety by the end of one year (8).

The standard method of controlling date insects in Iraq is spraying of store houses and fumigating dates with fumigant insecticides. However, the use of insecticides on stored foods or their products is becoming undesirable because insects may develop resistant strains to the insecticides (2, 5, 6 and 11) and harmful residues left on foods (9). Therefore, alternative methods for controlling insects on stored food are continuously searched for to replace chemical methods.

One of these methods is the use of heat (1, 7, 8 and 10) or storing grains in air tight underground storage (10) or the use of tight bags (12) or storing dates in polyethen bags freed from air (8).

This paper reports results of a study using vacuum with different lethal high temperatures, to control *E. cautella* which is a part of a project aimed at finding the effect of such technique on insects of stored dates.

MATERIALS AND METHODS

A culture of *E. cautella* was maintained in the laboratory as described

by (1) to supply any stage of this pest for testing. A vacuum-oven (Gallenkamp, England) supplied with temperature and pressure gages was used.

The temperature of the vacuum-oven was raised to 35, 40, 45 or 50°C, before placing the insects. Then air was evacuated in 10 minuttes to air pressure of 25-30 mm Hg. and was kept at this leval until the end of the test. Therefore, the length of the insect exposure time to vacuum and temperature started from time air evacuation began.

Eggs were introduced into the oven in petri-dishes over black filter papers; other stages were placed inside test tubes measuring 5.5-/10.0 cm long and 1-2 cm in diameter. The first instar larvae were given ground wheat and glycerine mixture of 88:12, the fourth instar larvae, dates, while the adults received 10% sugar solution in cotton placed on tops of the test tubes.

In each Petri-dish 25 eggs were placed, and in each tube 3-5 larvae or pupae or 1 male and 1 female. Each container represented one replica out of 3-5 replicates per treatment. The control for the treatment was kept under room temperature.

After the treatments, insects were removed to an incubator with optimal conditions consisted of 25°C and about 70% R.H. and were kept for up to 5 days to record mortality which was calculated according to Abbott's formula. The test was repeated when control death exceeded 10%.

Three to five mortalities for each temperature and insect stage were obtained. Then, they were plotted against exposure times on logarithmic probability graph paper no. 3128 (Codex Book Co. Inc. Mass., USA). A straight line was fitted to get estimates of the lethal times for 50 and 95% mortalities of the insect population expressed as LT50% and LT95%. In addition, more tests were conducted to obtain 100% kill, (LT100) of the tested population.

RESULTS AND DISCUSSION

When mortalities and exposure times were plotted on logarithmic probability paper and straight lines were fitted, then estimates for LT50 and

LT95 were obtained and recorded in Table 1. Actual mortality for LT100 of all stages of *E. cautella* are also shown in Table 1. The table enables comparison of the effects of vacuum and temperature on all stages of the fig moth.

Data in Table 1 show that different stages of the fig moth responded differently to vacuum and temperatures. Eggs were more resistant particularly at low temperatures (35-40°C) while adults were most susceptable than other stages. The LT50 for the eggs at temperatures 35-50°C ranged between 430 and 23 minutes respectively. On the other hand, the adult LT50 did not exceed 14 minutes. Similarly, the LT95 for the corresponding treatments were 1000 to 30 minutes for the eggs and up to 16 minutes for the adults.

The first and fourth instar larvae fall in their response to treatments between the resistant eggs and the susceptable adults. Hence, the LT50 for first instars under the same conditions ranged between 32 and 16 minutes and the LT95 ranged between 40 and 23 minutes. The effect of vacuum with room temperature on the larvae of *E.cautella* was studied by (7,8) and reported that when infested dates are packed in polythylene bags at 80% to 90% vacuum, the mortality of the moth larvae is 100% after two days.

When batches of pupae and adults were seperated into males and females and each was tested under vacuum with different temperatures, females showed higher resistance than the males (Table 2 & 3). At shorter periods of exposures at low temperature (35- 40°C) females, mortalities were nearly half of the males. But at longer periods of exposure, the gap between them became closer.

The effect of vacuum and temperature was also observed on egg laying and hatching of eggs that were laid by females survived the treatments. The results are shown in Table 4. In general, less eggs were laid by females exposed to combined effect of vacuum and temperature (average of all treatments was 10.3) than by females exposed to comparable temperatures (51.4) or to optimal temperatures of 25°C (157.2). Hence, the differences in the number of eggs laid by exposed females to vacuum and temperatures and that exposed to comparable temperatures was five times and with the optimal temperature (25°C) was nearly fifteen times. The rate of egg

hatching was similarly affected by the treatment. Less hatching occured among eggs laid by females exposed to treatments (average of all treatments was 31.2%) than among eggs laid by females exposed to comparable temperatures 72.5% or to optimal temperature (25°C) 83.6%.

The combine effect of temperature and vacuum seems to be more lethal to *E. cautella* than the effect of temperature or vacuum alone. This was revealed by the mortality of any stage which was higher under vacuum temperature combination than temperature alone (Table 5). Data in this table indicate that LT100 for any stage of the fig moth was obtained in about one half to one forty-eighth times that of comparable temperatures.

The effect of upper lethal temperature on insects was reviewed by(3). He indicated that for each species of insects, there is a fairly well defined range of temperature within which the organism remains viable. Beyond this limit, death occurs due to denaturation of proteins or melting of cellular liquids and phospholipids.

Desication due to evaporation is another cause for death(4). Evaporation in this experiment is expected to increase because vacuum removes moisture from the insect and its surrounding and causes a fast desication.

The same worker(4) has also reported that gradual increase in insect body temperature up to a certain level causes an increase in metabolic rate as expressed by fast development or more oxygen consumption. Here again, vacuum removes the much needed oxygen and thus enhances insect death by suffocation. All these factors explain the quick and high death rates among different stages of the fig moth in this experiment.

The LT50 and LT95 in Table 1 are estimates useful in comparing the sensitivities of *E. cautella* to combine effect of vacuum and temperature. But such estimates do not serve the main objective of this work which is the determination of the lethal times LT100 (Table 1) for each temperature and stage of the insect. The LT100 provides the bases for the application of this technique in insect control.

The LT100 in Table 1 was obtained for each of the moth stage and temperature from a series of tests. So their values in the table are actual and not estimates. To put this into practice, one can select the temperature,

apply the vacuum and maintain it to the time required to cause 100% mortality of the insect. Since, the eggs of *E. cautella* is more resistant to such treatment than the other stages, then the exposure time that kill the eggs at any temperature would definitely kill the larvae, pupae and the adults. As an example, at 35°C the LT100 for the eggs is 1090 minutes (Table 1). This is several times longer than what is needed to kill all the other stages of this insect at the same temperature.

From the practical point of view, 35°C and 40°C or even 45°C seem to be the most suitable temperatures if this method of control is used. Because , these temperatures may prevail inside and outside the store houses during the date harvesting season, not only in Iraq but in neighbouring countries as well, there would be no need to use energy to raise the store houses temperature if such method of control is adopted. But if heat treatment is applied to improve qualities of dates such as giving the dates a shiny appearance or glazing (8), then such treatment would improve the value of this method of control.

This work leads the way to further and similar studies on other insects of store dates and to be followed by studies aimed at developing suitable ways and put the results into practice. Finally, to evaluate this method of control with the common methods and adopt the most economic and less hazardous one to man.

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Table 1
Lethal time (LT) estimated for 50, 95 and actual for 100% mortality of different stages of *E. cautella* exposed to the effect of vacuum and temperature.

Stage	Temp.	Time (minutes) LT 50	LT 95	LT 100
Egg	35	430	1000	1090
	40	131	170	250
	45	49	59	190
	50	23	30	40
1st Inst. L.	35	32	40	50
	40	25	30	30
	45	17	21	30
	50	16	23	30
4th Inst. L.	35	23	36	50
	40	23	32	40
	45	20	30	40
	50	18	26	40
Pupa	35	23	33	60
	40	23	31	40
	45	20	25	40
	50	17	22	30
Adult	35	14	16	20
	40	13	16	20
	45	12	13	15
	50	14	16	20

Table 2

Mortality of male and female pupae of *E. cautella* exposed to vacuum with different temperatures for various periods of time

Temp.	Exposure Times (minutes)									
	20		30		40		50		60	
C°	M	F	M	F	M	F	M	F	M	F
35	74.9	32.0	79.1	72.0	91.6	95.8	96.0	92.0	100	100
40	47.6	33.2	96.0	88.0	100	95.8				
45	86.0	80.0	88.0	88.0	100	100				
50	89.6	84.4	100	100	100	100				

M: Male
F: Female

Table 3

Mortality of male and female adults of *E. cautella* exposed to vacuum with different temperatures for various periods of time

Temp.	Exposure Times (minutes)					
	13		15		20	
C°	M	F	M	F	M	F
35	20	10	80.0	82	100	100
40	52.4	30.4	72.0	68.0	96.0	100
45	88.5	80.0	100	100	100	100
50	50.0	30.0	70.0	66.7	93.3	100.0

M: Male
F: Female

Table 4

Effect of vacuum with different temperatures on the laying and hatchability of eggs of *E. cautella* females (10-25 females per treatment for each exposure time)

Temp. C°	Exposure Time (minutes)	Ave. T[1]	eggs/F C	% T	Hatching C
40	13	4.9	4.9	65.1	68.9
	15	12.4	35.2	9.4	55.7
	20	8.6	24.3	18.5	66.9
45	15	2.8	16.6	25.0	90.4
	20	1.5	2.9	25.0	46.9
50	13	23.7	—	51.5	—
	15	12.1	114.3	16.0	89.9
Ave.	20	16.3	161.8	33.9	88.7
		10.3	51.4	31.2	72.5
25 (control)	—	—	157.2	—	83.6

(1) T: Treatment
C: Control under same temperatures
F: Female

Table 5

Exposure time in minutes required for 100% mortality of different stages of *E. cautella* under the effect of temperature alone, and temperature-vacuum combination.

Stage	45°C		50°C	
	Temp.[1]	Temp. + Vac.	Temp.	Temp. + Vac.
Egg	900	190	180	40
1st Inst. L.	900	30	45	20
4th Inst. L.	1080	40	90	30
Pupae	600	40	180	20
Adult	720	15	75	20

(1) From Al-Azawi et al. (1981).

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WHOLESOMENESS STUDIES WITH A FULL DIET OF IRRADIATED DATES ON THE INSECT *Ephestia cautella* (Walker): II. EFFECTS OF HIGH DOSES OF GAMMA RADIATION.

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ABSTRACT

The present study was conducted to investigate the effect of dates treated with different high doses of gamma radiation and fed as a whole diet on the biology of *Ephestia cautella* to provide more information on the safety of irradiated dates with low doses for the purpose of insect disinfestation as well as for dibis production in the future by using high doses of gamma radiation.

The following results could be concluded when the data were statistically analysed:

1. When rearing 200 *E. cautella* eggs for 30 days on date fruits (both Zahdi and Sayer varieties, separately) irradiated with either 625, 1250, 2500, or 5000 krad of gamma radiation the average numbers of larvae and pupae developed were not different from the control.
2. No significant effect could be detected on the percentages of emerged adults or their sex-ratio when developed during 60 days of incubating the eggs on irradiated dates of both varieties.
3. Although the average percentages of malformed moths showed somewhat consistent increase as the radiation dose increased, these differences were not statistically significant.

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4. The average number of eggs per female and the average percentage of egg hatch were similar in different crosses of either adults developed on irradiated or unirradiated dates, or between them and adults of the control.
5. Rearing insects on irradiated date fruits with such doses of gamma radiation has no significant effect on the fecundity and fertility of their F_1 progeny.
6. These extremely high doses of gamma radiation caused significant increase in the softness of date fruits of both varieties.
7. Significant delay of development of pupae caused by 2500 and 5000 could be attributed to increase in stickiness.

دراسات حول سلامة التمور المشعة المستعملة كغذاء ،كامل لحشرة عثة التين (Walker) *Ephestia cautella*:
2 ـ تأثير الجرعات العالية من أشعة كاما .

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الخلاصة

يتضح من النتائج التي تم تسجيلها سابقاً أن انتاج الدبس (عصير التمر) يزداد كثيراً اذا ما عرضت التمور الناضجة الى جرعات عالية (257 - 2000 كيلوراد) من أشعة كاما . لذا أجرى البحث الحالي لدراسة تأثير التمور المشعة بمختلف الجرعات العالية من أشعة كاما والمستعملة كغذاء كامل على حياتية حشرة عثة التين افيستيا كوتيلا *E. cautella* بغية الحصول على معلومات أوفر تؤكد سلامة

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التمور المشعة بجرع واطئة لغرض تعقيمها من الحشرات من ناحية وتكشف عن تأثير أشعة كاما إذا ما استعملت في انتاج الدبس من التمور في المستقبل من الناحية الأخرى. ونتيجة لتحليل نتائج التجارب احصائياً تبين ما يلي:

1 - إن معدل اعداد اليرقات والشرانق الناتجة من ترك 200 بيضة افيستيا كوتيلا لفترة 30 يوماً على تمور مشعة بالجرعات 625، 1250، 2500، و 5000 كيلوراد من أشعة كاما غير مختلفة احصائياً عند مقارنتها بالتمور غير المعاملة في الصنفين الزهدي والساير.

2 - لم يلاحظ تأثير واضح على النسبة المئوية للبالغات الناتجة ونسبها الجنسية بعد فترة 60 يوماً من حضانة البيض على تمور كلا الصنفين مشعة بالجرع المذكورة أعلاه.

3 - بالرغم من ظهور زيادة مطردة مع زيادة جرعة تشعيع التمور في معدل النسبة المئوية للحشرات الكاملة المشوهة إلا أن هذه الفروق غير معنوية احصائياً عند مقارنتها بغير المشعة في كلا الصنفين من التمور.

4 - لم يلاحظ تأثير واضح على معدل عدد البيض للأنثى الواحدة ومعدل النسبة المئوية لتفقيس البيض الناتج من مختلف التزاوجات التي أجريت سواء بين البالغات الناتجة من تمور مشعة أو بينها وبين البالغات الناتجة من الوسط الغذائي المختبري.

5 - إن تربية الآباء من البيضة وحتى البالغة على تمور مشعة بمثل هذه الجرعات العالية من أشعة كاما لم تظهر أي تأثير معنوي واضح على خصوبة حشرات جيلها الأول.

6 - إن هذه الجرع العالية من أشعة كاما سببت زيادة معنوية ومطردة في ليونة ولزوجة التمور المعاملة.

7 - ظهر تأخير معنوي في سرعة النمو من طور اليرقة الى الشرنقة عند التربية

على تمور مشعة بجرعتي 2500 ، 5000 كيلوراد من أشعة كاما وقد تكون زيادة لزوجة التمور هي السبب المحتمل.

INTRODUCTION

Disinfestation of agricultural commodities by ionizing radiation has proved its value as an environmentally clean physical method because of the limitations imposed by the possibility of health hazards arising from chemical residues in the different elements of the environments (1). However, it is generally accepted that wholesomeness tests must be carried out before any international clearance could be granted to the irradiated food. So far, such tests have been based on animal feeding studies, using the same criteria as for the safety assessment of food additives (15). Therefore, the joint FAO/IAEA/WHO expert committee on the wholesomeness of irradiated food has recently considered that food irradiation is a food treatment process, comparable to other physical processes such as cooking under heat and pressure, and recommended that safety evaluations of irradiated foods should be approached on the basis of better knowledge of both qualitative and quantitative changes in the food caused by radiation (18).

As in many biological studies, insects are thought to be as important as small laboratory animals in the evaluation of the effect of food treated with different chemical or physical methods (16). This may be due to their short life-cycle, high reproductivity and low cost of rearing. As usual, *Drosophila melanogaster* played a pioneering role in the investigations on the mutagenic effect of irradiated food, however, the results appear to be conflicting (12). Similarly, controversial results on the effect of irradiated food on insect development were also reported using other insect species such as stored-product insects (10,13,14,17).

Our previous studies have shown that disinfestation of Iraqi dates can be achieved by rather low doses of gamma radiation (3,5). At the same time, Farkas et al. (11) have found that the dibis (date syrup) yield from fully ripen (rutab) date fruits was highly increased when irradiated with high doses (275 - 2000 krad) of gamma radiation.

Most recent results of our studies have shown that no significant changes could be detected in some developmental and genetical parameters of the fig moth *Ephestia cautella* when reared from egg to adult, for one or several generations, on a 100% diet of dry dates irradiated with disinfestation doses (50 - 100 krad) of gamma radiation (6). On the other hand, irradiation of dates with high doses (2500 - 5000 krad) of gamma radiation was found to produce lethal effect in the coleopteran *Oryzaephilus surinamensis* when raised from egg to adult on a full diet of these fruits (4).

Thus, it was thought advisable to carry out further studies on the effect of dates treated with different high doses of gamma radiation, and used as a whole diet, on the biology of *Ephestia cautella* as an attempt to contribute more information on the wholesomeness of irradiated dry dates.

MATERIALS AND METHODS

The details of the *E. cautella* strain used in the present studies, and the procedure of egg collection were recorded elsewhere (6).

Irradiation of dates was carried out using Cobalt-60 source of the type Gammacell-220 at a dose rate of approximately 70 rad per second of gamma radiation. Selected date fruits were divided into 5 groups and treated with following doses: 0 (control), 625, 1250, 2500, and 5000 krad, respectively, then 35 dates of each group were placed in a one-liter beaker. Immediately after irradiation, each beaker was seeded with 200 eggs, then sealed and incubated at approximately 25°C and 50 - 60% relative humidity. Two replicates were done for each dose simultaneously, and the whole experiment was repeated twice.

After 30 days, all beakers were opened, and each date fruit was carefully examined, and the number of insects at different stages were counted and recorded. The immature stages (larvae) were left to complete their development for another 30 days. During this period all beakers were examined two times a week for pupation and subsequent adult emergence.

The enclosed adults were collected, counted and different crosses were made either between themselves or between them and moths of opposite sex from the laboratory wild type stocks which are usually fed on the

rearing medium mentioned earliar (6). Female fecundity, mating frequency, and egg hatchability were determined. Futhermore, in some doses samples of eggs from all crosses were reared on the laboratory medium and the developed F_1 adults were investigated for inherited sterility.

Softness of irradiated dates was determined within one hour after treatment, 10 fruits of each dose were selected, their stones and perianths were gently removed out using a fine forceps, then the outer hard skin of each fruit was carefully peeled off with a sharp scalpel, and placed on a filter paper fixed on a wire mesh. A petri dish was then gently placed on the date fruit and a standard weight of one kilogram was then carefully placed in the petri dish and left for a period of 1 minute. After lifting off the weight, the date fruit will appear pressed and stuck to the filter paper. The edges of the pressed fruit was marked with a pen before removing the fruit from the filter paper. The area drawn can then be determined using a planometer and the average of areas of 10 fruits of each dose could be used as an indicator of softness induced by gamma radiation. The softer the date fruit, the larger the area measured will be.

RESULTS AND DISCUSSION

It is of interest to mention that the average periods of development of *E. cautella* from egg to adult were about 40 and 30 days when reared on dry dates and on laboratory medium of crushed wheat/date syrup/glycerin/ dried yeast, respectively, and kept at 25° C and 50 – 60% relative humidity. The developmental results after 30 days of rearing the eggs are shown in Table 1. It is clear that the average numbers of larvae developed on irradiated dates at all doses are not significantly different from that of the unirradiated dates. As for the pupae, the statistical analysis of the results indicated that dates irradiation with 2500 or 5000 krad of gamma radiation, significantly lowered the average number of pupae developed within the 30 days of incubation, while the dates treated with 625 or 1250 krad, did not show significant differences in this respect when compared with the number of pupae developed in the control. However, no significant differences were found when the total number of all develop-

mental stages (larvae + pupae) were compared between the irradiated and unirradiated dates.

The final results of development after 60 days of rearing are listed in Table 2. No statistically significant differences were found between the average numbers of adults developed on irradiated dates with such doses. In fact, significant increase in the number of adults was noticed on Zahdi dates treated with 625 and 1250 krad of gamma radiation when compared with that of unirradiated dates. Although the percentage of adults developed with body malformations showed somewhat consistent increase as the radiation dose increased, the differences between them and the control were found to be statistically insignificant. Furthermore, the sex ratio of the emerged adults was 1 : 1 in all cases.

Table 3 shows the results of an experiment carried out to estimate the degree of softness of irradiated date fruits. These results clearly demonstrate the gradual increase in the pressability of date fruits with the increase of the irradiation dose as indicated by the average area of pressed dates. However, statistical analysis of these results have shown that only the average areas of pressed fruits exposed to 2500 or 5000 krad of gamma radiation are significantly larger than that of the unirradiated dates.

Table 4 shows the results of different crosses between either the adults developed on irradiated or unirradiated dates, or between them and adults of the opposite sex of the laboratory stocks. The statistical analyses indicated no significant effect when some physiological parameters, such as female fecundity as measured by the number of eggs laid by each female, or genetical parameters such as dominant lethal mutation as estimated by the percentage of egg hatch were considered.

In order to investigate the possibility of induction of inherited sterility in insects, as a consequence of rearing their parents on dates irradiated with different high doses of gamma radiation, different crosses were made between F1 progeny produced from some of the crosses mentioned in Table 4, and adults reared on laboratory medium. The results are listed in Table 5, which clearly show that rearing the parents on irradiated date fruits has no effect on the fecundity and fertility of their progeny.

Tables 6 and 7 show the results of an experiment carried out similar to those reported in Tables 1 and 2, but using another date variety, locally known as Sayer, which is different in shape, colour and texture of the fruits, but it is as economically important as Zahdi variety. Similarly, no significant differences could be detected in the average numbers of larvae and pupae produced within 30-day incubation period, or in the average number of normal and malformed adults developed on irradiated Sayer date fruits when compared with insect development on unirradiated ones.

All available data indicated that dry dates can be easily disinfested with low doses (50 - 100 krad) of gamma radiation (1,2). Furthermore, studies on the chemical composition of irradiated dates indicated that there are no detectable changes in sugars, proteins and amino acids when high doses of gamma radiation were applied (8,9).

Several varieties of irradiated food were tested for their safety using feeding studies of small mammals. Most of these studies did not show any harmful effects on animals raised on irradiated food at different proportions of the total diet (15). However, it is thought that the period of feeding and the ratio of irradiated to unirradiated components of the food in the diet plays an important role in these respects to reveal the actual effect (3,4). Thus, such feeding tests using only a certain percentage of irradiated food in the diet may not lead to accurate detection of various measurable effects, hence giving rise to contradictory conclusions.

In spite of the fact that insects, particularly stored-product pests, can be reared on a full diet of irradiated foods, few studies have been made on the wholesomeness of irradiated food using them as experimental animals. Such studies were mainly carried out on irradiated flours, wheat, beans and dates. The results of the majority of these studies indicated that irradiation of such food commodities with doses up to 500 krad of ionizing radiation are not harmful to insect development and fecundity (3,10,13,14,17).

From the data reported here, it is evident that dates irradiated with doses of 625 and 1250 krad, which are 10 - 20 times higher than the dose needed for insect disinfestation, did not apparently cause adverse effects on either the development of larvae and pupae or on the survival and the sex-ratio of

adults of *Ephestia cautella*. Thus, our results are in a general agreement with the findings of the above mentioned authors. In fact, irradiation of the date fruits with these two doses caused a significant increase in the number of adults obtained in comparison with the control. This increment might be due to the increased softness of the date flesh by radiation to a more edible texture (11).

In this respect, it is interesting to mention that the data of the present study were included in the list of scientific reports examined as evidence by the joint FAO/IAEA/WHO Expert Committee met in 1980 at Geneva to evaluate the wholesomeness of irradiated food. The recommendation was unconditional clearance for the irradiated dates for disinfestation purposes at an average dose of up to 1KGy (i. e. 100 krad) (19).

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Table 1

Average numbers of larvae and pupae developed from 200 eggs (4 replicates) of *Ephestia cautella* reared for 30 days on irradiated dates (Zahdi variety) with different doses of gamma radiation.

Radiation dose (krad)	No. of larvae ± S.D.	No. of pupae ± S.D.	No. of larvae + pupae ± S.D.
0	58.25± 5.06	6.75±3.20	65.00± 7.72
625	59.24±20.12	6.50±4.12	65.75±19.65
1250	68.75±17.25	4.50±2.52	73.25±16.78
2500	60.50±10.50	0.75±96*	61.25±10.81
5000	60.00±26.72	0.75±0.96*	60.75±27.56

* These averages are significantly different from their control at $P < 0.05$.

Table 2

Average numbers of adults developed from 200 eggs (4 replicates) of *Ephestia cautella* reared for 60 days on irradiated or unirradiated dates (Zahdi variety) with different doses of gamma radiation.

Radiation dose (krad)	No. of adults ± S.D.	% adults ± S.D.	% malformed adults ± S.D.	% female
0	35.0±4.24	17.50±2.12	4.21±2.48	52.14
625	45.0±5.94*	22.50±2.97*	4.94±5.75	50.00
1250	46.5±6.40*	23.25±3.25*	4.84±3.93	49.46
2500	33.5±4.20	16.75±2.10	9.88±6.47	50.78
5000	32.0±7.32	16.00±3.67	12.63±8.68	50.78

* These averages are significantly different from their controls at $P < 0.05$.

Table 3

Area of pressed date fruits by one kilogram weight for one minute on filter paper immediately after irradiation with different doses of γ-rays (average of 10 date fruits).

Gamma Dose krad	Area of pressed date with 1kg/1 min $cm^2 \pm$ S.D.	t-value compared with control	Significant
0	7.353±0.717		
625	7.973±1.093	1.548	$P > 0.1$
1250	8.070±1.005	1.837	$P > 0.05$
2500	9.087±0.867	4.883	$P < 0.001$
5000	10.367±2.239	4.050	$P < 0.001$

Table 4

Fecundity and egg hatchability percentage of different crosses of *Ephestia cautella* adults reared on irradiated and unirradiated dates (Zahdi variety).

Dose	No.	N × R		No.	R × N		No.	R × R	
	No. of pairs	No. of eggs /female ± S.D.	Hatch. % ± S.D.	No. of pairs	No. of eggs /f±S.D.	Hatch. % ± S.D.	No. of pairs	No. of eggs /f±S.D.	Hatch. % ± S.D.
0	18	270.6±152.6	77.3±19.4	25	200.8± 86.1	85.1±15.3	17	191.2±95.9	82.6±14.9
625	18	280.8±112.9	84.1±10.3	23	275.0± 93.3	73.6±30.3	15	224.5± 93.6	70.5±27.8
1250	20	243.5±105.1	83.9±19.4	22	235.7±114.4	61.8±40.6	16	244.1± 92.4	67.3±34.8
2500	14	299.3±115.8	85.1±10.2	17	216.5±108.8	83.9±12.2	15	217.1±106.6	82.6±11.4
5000	21	252.2± 94.5	70.2±30.0	17	185.5± 84.1	77.1±19.3	21	199.7± 76.1	83.6±10.8

N: Control Adults, i.e. fed on crushed wheat + 12% glycerin

R: Treated Adults, i.e. fed on either irradiated or on unirradiated dates.

Table 5

Fecundity and egg hatchability of F_1 adults of *Ephestia cautella* produced from insects fed as larvae on irradiated or unirradiated Zahdi date fruits.

Crosses	Control (0 kard)			1250 krad			5000 krad		
	No. of pairs	No of eggs/ female ± S.D.	% hatch. ± S.D.	No. of Pairs	No. of eggs/ female ± S.D.	% hatch. ±S.D.	No. of pairs	No. of eggs/ females ± S.D.	% hatch. ± S.D.
N × R	18	270.6±152.6	77.3±19.4	20	343.5±105.1	83.9±19.4	21	252.2± 94.5	70.2±29.9
N × F_1	20	304.1±116.8	75.8±29.6	11	295.9±137.6	89.1±5.3	19	243.1±110.6	76.7±21.2
F_1 × N	15	297.9± 91.9	87.7± 4.7	10	228.4±128.4	69.7±34.9	16	257.9± 75.7	78.5±16.1
F_1 × F_1	14	304.0±117.3	82.8±14.8	6	336.0±106.1	88.4± 6.3	13	253.5±140.1	71.3±25.1
R × N	25	200.8± 86.1	85.0±15.3	22	235.7±114.4	61.8±40.6	17	185.5± 84.1	77.1±19.3
N × F_1	27	276.3±128.2	78.1±24.6	17	244.0±100.2	87.4± 7.7	19	295.2±119.2	75.9±16.3
F_1 × N	26	303.8±135.0	75.2±25.0	6	239.0±108.9	67.0±34.1	6	317.0± 55.1	85.8±12.6
F_1 × F_1	24	301.1±102.2	78.3±25.1	10	273.7± 64.7	83.9±11.3	4	223.5± 87.2	75.6± 8.7
R × R	17	191.2±95.9	82.6±14.9	16	244.4± 92.4	67.3± 8.0	21	199.7±76.1	83.6±10.8
N × F_1	5	181.6± 90.2	75.6±25.0	12	313.2±112.3	79.8±22.9	11	246.6± 79.3	84.7±9.9
F_1 × N	4	208.5±109.4	74.5±12.7	5	239.2±176.3	78.3±34.7	13	291.4±104.6	79.8±14.5
F_1 × F_1	9	227.7±134.8	78.6±11.7	8	176.7±106.1	69.0±30.6	18	280.1± 76.1	75.5±22.9

R: adults developed on either irradiated or unirradiated dates.

N: Adults developed on laboratory medium

Table 6

Average numbers of larvae and pupae developed from 200 eggs (4 replicates) of *Ephestia cautella* reared for 30 days on irradiated and unirradiated dates (Sayer variety) with different doses of gamma radiation.

Radiation dose krad	No. of larvae ± S.D.*	No. of Pupae ± S.D.*	No. of Larvae + Pupae ± S.D.*
0 (control)	64.00±10.02	5.75±2.58	69.75±12.60
625	63.00±16.15	7.00±3.96	70.00±20.11
1250	63.75±13.74	6.50±3.66	70.25±17.40
2500	61.00±11.93	5.50±2.73	66.50±14.66
5000	65.25±17.12	3.75±2.84	69.00±19.96

* These averages are not significantly different from their controls at $P < 0.05$.

Table 7

Average numbers of adults developed from 200 eggs (4 replicates) of *Ephestia cautella* reared for 60 days on irradiated and unirradiated dates (Sayer variety) with different doses of gamma radiation.

Rdiation dose (krad)	No. of adults ± S.D.*	% adults ± S.D.*	%malformed adults ± S.D.*	% female
0 (control)	45.00±4.13	22.50±2.02	4.44±2.58	51.92
625	45.50±4.94	22.75±2.48	4.39±2.38	50.45
1250	44.75±4.41	22.38±2.32	6.70±3.81	50.77
2500	42.00±6.23	21.00±3.25	7.14±5.72	52.08
5000	40.75±8.67	20.38± 3.91	12.27±8.30	51.22

* These averages are not significantly different from their controls at $P < 0.05$.

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SHORT COMMUNICATION

A NEW PHYSIOLOGICAL DISORDER: PARTIAL YELLOWING IN DATE PALM FRONDS IN U.A.E.

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Partial yellowing is a minor disorder of date palms in UAE. It consists of yellowing of some pinnae on one side of the frond. This is encountered on only few trees on some grooves in Fujairah and Al-Ain areas. It first came to our attention on January 24, 1983 when a sample came to our Central Laboratories (Al-Ain) for checking. In the Central Laboratories (Plant Science and Crop Protection Section) we could isolate neither bacteria nor fungi responsible for this yellowing. *Alternaria* sp. was isolated from secondary infection of some brownish spots on leaves, but was not the major cause of this yellowing.

Some fresh samples were sent to Department of Plant Pathology (Virology Section), Rothamsted Experimental Station, England. They confirmed that neither mycoplasma nor virus particles were isolated from the sample.

We carried out nutritional analysis checking for macro- and micro- elements on both sides of the same frond, the greenish and yellowish ones.

Samples were analysed for: P, K, N, Na, Ca, Mg, Fe, Mn, Zn and Cu using AOAC (1980) procedures. The results [Table 1] have shown that P and K in the yellowish side of the frond were almost 3 times more than what was available in the greenish side of the frond. Na on the yellowish pinnae was found to be almost twice more than what was available on the

greenish side. On the contrary, Ca, Fe and Mn on the greenish side, were almost twice what was available on the yellowish side. This imbalance of major and minor elements might be the reason for this physiological disorder. The real cause for this imbalance has not yet been known. However, it is worth to mention that the yield obtained from these trees seemed not to be affected by this partial yellowing.

LITERATURE CITED

AOAC (1980): Official methods of analysis of the Association of Official Analytical Chemists. 13th ed., Washington, D.C.

TABLE 1

Macro- and micro- element content of yellowish and greenish pinnae of date palm fronds

Sample	% Macro-elements						ppm Micro-elements			
	Total N	P	K	Na	Ca	Mg	Fe	Mn	Zn	Cu
Green Pinnae	1.0	0.17	0.42	0.24	0.3	0.36	345	62	10	9
Yellow Pinnae	0.95	0.43	1.3	0.55	0.15	0.23	175	32	9.5	10

Figure showing Partial Yellowing of Date Palm Frond reported from U.A.E.

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DOCUMENTATION

A BIBLIOGRAPHY OF GRADUATE THESES ON THE DATE AND OTHER PHOENIX SPP.

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INTRODUCTION

Master's and doctoral theses completed as part of higher university degrees represent original research, but are difficult to identify because they are not indexed in standard science reference books or abstracting periodicals. If the author of a thesis does not publish material from it, the findings are virtually lost to science. This short bibliography has been compiled to present theses dealing with the date palm and its products, as well as studies undertaken on other species of the genus *Phoenix*. These latter may prove useful to date palm researchers in terms of germplasm resources, disease control, etc. A separate general bibliography on the agronomic, botanical and economic aspects of palms and their products is published in *Principes*, Journal of the Palm Society, Vol. 27, 1983.

The eleven theses listed here were completed at universities in India (four), the United States (four), Iraq (one), U.K (one) and Tunisia (one). The list was meant to be inclusive, but some items may be missing. Because it was impossible to verify the accurancy of each title with the university granting the degree, some minor errors may be present.

BIBLIOGRAPHY

Ammar, S. 1978. La culture de tissus de plantes issues de graines appliquée à la multipli-

cation végétative du palmier dattier *(Phoenix dactylifera L.)*. Université de Tunis, Tunisia.

Biradar, N.V. 1967. Studies in fossil plants from Kota-Maleri beds, and embryology of the genus *Phoenix* Linn. University of Poona, India. (PhD)

Feather, T.V. 1982. Occurence, etiology and control of wilt and dieback of *Phoenix canariensis* in California, Riverside.

Gunamani, M. 1980. Developmental studies on axillary growths in some palms. *(Phoenix farinifera, Bentinckia condapanna)* Madurai Kamaraj University, India. (PhD)

Hilgeman, R.H. 1951. The differentiation, growth and anatomy of the axis leaf, axillary bud, inflorescence and offshoot in *Phoenix dactylifera* (Linnaeus). University of California, Los Angeles. (PhD)

El Jarrah, Amina. 1977. Physico-chemical and histological dynamic changes in Khadrawi date fruit. Baghdad University (MSc)

Al-Obaidi, Z.S. 1977. Citric acid production from date syrup. Department of Applied Microbiology, University of Strathclyde, Glasgow, UK. (PhD)

Osman, A.M. 1975. Xenia and Metaxenia studies on date palm *Phoenix dactylifera L.* University of California, Riverside. (PhD)

Parthasarathy, M.V. 1957. Studies on palms: anatomy of the genus *Phoenix* L. University of Poona, India. (MSc)

Rashid, I.A. 1950. Oxidizing enzymes in dates in relation to the darkening of the fruit. University of Massachusetts, Amherst. (PhD)

Veerasamy, S. 1979. Morphological and ontogenetic studies in palms. *(Borassus flabellifer, Corypha umbraculifera, Phoenix dactylifera, P. sylvestris)* University of Mysore, India. (PhD)

ABSTRACTS OF RECENT RESEARCH ON THE DATE PALM

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Centre in the Near East & North Africa, Baghdad, Iraq.

Production

HAURY, A. A study of date palm behaviour in Niger: Bonkoukou, Dallol Bosso. Fruits 1982, 37(10): 627-633.

Data are presented on the growth, flowering and yields of Fari and Tazaw-Zaw date cultivars from 1975 to 1980; these were planted as part of an experimental oasis in which the palms would provide shade for citrus, mango and guava trees. No information is yet available on this aspect.

Botany

DE MASON, D.A. & STOLTE, K.W. Floral development in *Phoenix dactylifera*. Canadian Journal of Botany 1982, 60(8): 1439-1446 (20 ref., 38 pl.). California University, Riverside, CA 92521, USA.

Inflorescence primordia in the date palm differentiated within axillary buds in November in the Coachella Valley, California. The rachillae were initiated as small mounds without subtending bracts on the flattened apex of the rachis and were enclosed by the prophyll. A single bract subtended each flower primordium. Flower primordia were initiated in an acropetal sequence along the rachillae. Although mature flowers were functionally unisexual, early development was similar in staminate and pistillate flowers. Six perianth parts were initiated within 2 alternating whorls: the sepals and the petals. Six stamens were initiated in 2 alternating whorls of 3 stamens each, the first opposite the sepals and the second opposite the petals. Lastly, 3 separate carpels were initiated. Pistillate and staminate flowers were identical and apparently bisexual at this stage. The 2 flower types diverged developmentally when the stamens became bilobed and elongated in the staminate but not in the pistillate flowers. The pistillodes in the staminate flowers formed rudimentary stigmatic surfaces at the tip of the carpels and meristematic lumps corresponding to the position of the ovule in normal carpels. The staminodes matured in the pistillate flowers as small triangular projections. Meiosis occurred in staminate and pistillate flowers (in March) when the staminate flowers were about 5 mm long and the pistillate flowers about 3 mm long.

Varieties

SRIVASTAVA, H.C. & DHAVAN, S. Performance of some date varieties in Haryana. Agricultural Science Digest 1981, 1(2): 76-78. Haryana Agricultural University, Hissar 125004 - India.

Fruit size, weight, colour, shape, chemical composition, flavour and bearing were determined in 5 date cultivars planted in Haryana in 1967. The findings are presented. The cultivar Hillawi, being the least susceptible to rain and high humidity, was the most suitable for growing locally.

YOUSIF, A.K., BENJAMIN, N.D., KADO, A., ALDDIN, S.M. & ALI S. M. Chemical composition of four Iraqi date cultivars. Date Palm Journal 1982, 1(2): 285-294 (En. with Ar. summ. 19 ref.).

The contents of total sugars, protein, fat, ash, crude fibre, vitamins, Ca, P, K, S, Na, Cl, Mg, Fe, Mn, Cu, Zn, Co and F were determined in ripe fruits of Hallawi, Sayer, Khadrawi and Zahdi date cultivars. The data are tabulated. Hallawi had the highest total sugar (87.9%) and riboflavin (173 mg/100g) contents, whereas Sayer had the highest thiamine (130 mg/100g), folic acid (70 mg/100 g) and ascorbic acid (17.51 mg/100 g) contents.

Growth regulators

ASIF, M.I., AL-TAHIR, O.A. and FARAH, A.F. The effects of some chemicals and growth substances on pollen germination and tube growth of date palm. Hort Science 1983, 18(3): 479-480. Date Research Centre, KFU, Al-Hassa, Saudi Arabia.

Boric, fumaric, gibberellic (GA), indoleacetic (IAA), and succinic acids at concentrations of 0.05, 0.5, 5, 50, or 100 ppm in a basic sucrose and agar medium stimulated pollen germination and tube growth of date palm *(Phoenix dactylifera* L.). Both germination and tube growth increased with increasing concentration of boric acid, GA, and IAA without injurious effects. Maximum pollen germination was observed at 0.05 ppm succinic acid and 0.5 fumaric acid.

EL-TANAHY, M.M., AGAMIA, E.H. & ABDEL-HAMED, N.M.G. Effect of Ethrel and pyrogallol on physical and chemical properties of Hayany date fruits. Annals of Agricultural Science 1982, 18: 235-249 (En. with Ar. summ.).

In 2 year trials, Ethrel (ethephon) or pyrogallol, each at 750-1500 p.p.m., was applied to Hayany date palms some 26 days before harvest. Ethrel and pyrogallol at the highest rates hastened ripening by 9 and 6 days resp. Both treatments hastened colour development and increased fruit TSS and total sugars and decreased total tannins, titratable acidity and moisture contents.

Morphology & Physiology

De MASON, D.A.; SEXTON, F. & REID, J.S.G. Structure, composition and physiological state of the endosperm of *Phoenix dactylifera L.* Annals of Botany. 1983, 52 (1): 71 – 80.

Dates endosperm consisted of living cells with the same general cellular structure throughout the seed. Major storage products, as shown by histochemical staining, were lipid, stored as numerous small lipid bodies which filled the cytoplasm, and protein, as large but variably-sized protein bodies. Nuclei were present but lacked large amounts of heterochromatin. Plastids and mitochondria were present but infrequently seen and had poorly developed internal membranes. No endoplasmic reticulum or dictyosomes were present before or after hydration. The cell wall was thick except in areas of pit fields and consisted of three layers: middle lamella, thickened wall and inner wall. Both the endosperm and embryo of the imbibed seed respired aerobically, but the embryo respired at a more rapid rate than the endosperm. A small area of the endosperm around the distal pole of the cotyledon showed histochemically detectable levels of succinic dehydrogenase.

SAWAYA, W.N.; KHATCHADOURIAN, H.A.; KHALIL, J.K.; SAFI, W.M. & AL-SHALHAT, A. Growth and compositional changes during the various developmental stages of some Saudi Arabian date cultivars. Journal of Food Science 1982, 47(5): 1489-1492, 1497 (En. 23 ref.). AUB/USDA, Ministry of Agriculture and Water, Riyadh, Saudi Arabia.

Compositional changes during fruit maturation were studied in the date cvs Khudari and Sullaj. Fruit weight, length and diameter, and weight of seed, were highest at the mature colour stage. Moisture, total nitrogen, fat, fibre, ash, tannins, vitamin C, β-carotene, and 10 essential minerals were all highest at the early stages of development and decreased during maturation. Reducing sugars were dominant in both cvs and showed progressive increases during ripening, with fructose and glucose as the only detected constituents. Sucrose content reached its maximum in both cvs at the mature colour stage and then dropped sharply at the ripe stage. The

total sugar content in both cvs tended to increase throughout maturation.

Pollen & Pollination

AL-TAHER, O.A. & ASIF, M.I. Stain testing of date pollen viability. Date Palm Journal 1982, 1 (2): 233-237 (En. with Ar. summ.).

Date palm pollen collected from matured ripe spadices of different local cultivars were cold-stored and then stained by the following agents: Potassium iodide Aniline blue, Nitro blue tetrazolium, and 2, 3, 5-triphenyl tassium iodide, Aniline blue, Nitro blue tetrazolium, and 2,3,5-triphenyl tetrazolium bromide (MTT). Correlation coefficients between pollen staining percentage with either of the first 4 agents and pollen germination percentage were low and not significant but were positive and significant when MTT was used.

TISSERAT, B. & De MASON, D.A. A scanning electron microscope study of pollen of *Phoenix* (Arecaceae). Journal of the American Society for Horticultural Science 1982, 107 (5): 883-887 (En., 28 ref., 20 pl).

Pollen grains of 4 cultivars and clones of *Phoenix dactylifera,* 2 clones of *P. reclinata,* and one clone each of *P. humilis, P roebelenii* × *P. paludosa, P. rupicola* and *P. sylvestris* were all monosulcate and elliptical and had tectate-perforate exines. Cultivars could be distinguished by differences in pollen morphology, including the presence or absence of wax-like substances, grain length, grain width, and grain length: width ratio, and by differences in exine structure including the shape, pattern, size and frequency of tectal perforations. Morphological and structural characteristics may be of use in the taxonomic identification of staminate cultivars in *Phoenix.*

Irrigation

ABOU-KHALED, A., CHAUDHRY, S.A. & ABDEL-SALAM, S. Preliminary results of a date palm irrigation experiment in Central Iraq. Date Palm Journal 1982, 1(2): 199-232 (En. with Ar. summ.).

In trials with 20-year-old Maktoom, Braim, Barhee and Sayer date palm cultivars intercropped with 5-year-old citrus trees, the total water con-

sumption of the palms was 18 000m^3 / ha annually of which 12 000m^3 came from irrigation, 5 000m^3 from the water table (5. 3-4m depth) and 1 000m^3 from rainfall. Some 70 – 74% of palm feeder roots were found in the top 120cm of soil. The recommended irrigation programme is 10 irrigation/year of which 6 (2/month) should be given in June, July and August.

Processing & Products

ANGELES BARCELON, M. DE LOS, McCOY, R.E. & DONSELMAN, H.M. New liquid chromatographic approaches for free amino acid analysis in plants and insects. II. Thin-layer chromatographic analysis for eighteen varieties of palm trees. Journal of Chromatography 1983, 260 (1): 147-155.

Analyses presented for free amino acids in the foliage of 18 palms, including date palms, a possible correlation was observed between the presence of arginine in the palms studied and susceptibility to lethal yellowing disease.

BENJAMIN, N.D.; ABBAS, M. F. and SHUBBAR, B.H. Preparation and clarification of a date juice 1 – Preparation. Journal of Research for Agriculture and Water Resources 1982, 1 (2): 75-87. (En. with En. & Ar. summs.). Agriculture and Water Resources Research Centre, Fadalyah, Baghdad, Iraq.

Zahdi dates were pitted, cut into small pieces and stirred with warm water at the relevant temperature, percent draft, and diffusion time to a slurry consistency, squeezed with cheese-cloth and centrifuged to obtain date raw juice. The percentage of soluble solids, pectin, invert and total sugars, recovery volume of juice, clarity and rate of total sugar extraction were determined. All chemical and physical characteristics of the raw juce and the residual cake were influenced by these variables. The optimum conditions (temperature, diffusion time percent draft and date pulp surface area) to maximize the extraction rate of 96% and better with a raw juice of maximum sugar minimum non-sugar content were 85°C, 50 minutes, 250% draft and slightly flaked.

GROSS, J.; HABER. O. & IKAN, R. The carotenoid pigments of the date. Scientia Horticulturae, 1983 20 (3): 251 – 57.

The pigments were investigated in the 2 soft cultivars Hayany and Barhee and in the semi-dry cultivar Deglet Noor. The total carotenoid content in ripe fruit was 10-12 μg/g fresh weight. The carotenoid pattern in all investigated fruits was that of the chloroplast type, with only slight differences between the cvs. During ripening, in Hayany and Deglet Noor, the total carotenoid content decreased from 36.3 to 21.2 μg/g dry weight in the soft dates, and from 23.2 to 12.0 μg/g dry weight in the semi-dry dates. Carotenoid degradation was due primarily to the loss of moisture during maturation and was unrelated to the gradual darkening of the ripening fruit. The pattern of the retained carotenoids remained essentially similar. Vitamin A values of the 3 cultivars expressed as retinol equivalents, were also calculated.

KAMEL, B.S.; DIAB, M.F.; ILIAN, M.A. & SALMAN, A.J. Nutritional value of whole dates and date pits in broiler rations. Poultry Science 1981, 60: 1005-1011. Food Research Division, Kuwait Institute for Scientific Research, P.O. Box 24885, Safat, Kuwait.

Two experiments were conducted to determine the feeding values of date pits and whole dates for broiler chicks. In the first experiment, ground Zahdi date pits were included in broiler diets at 5, 10, and 15% replacing wheat bran, corn, and alfalfa with and without zinc bacitracin (50 ppm) supplementation. In the second experiment, whole Zahdi dates were incorporated in diets at 0, 5, 10, and 47.7%, replacing corn as an energy source. The diets were kept isonitrogeneous and isocaloric in both experiments. The results indicate that the date pits used supported chick growth as efficiently as the control diet at all dietary levels tested. When zinc bacitracin was added to the diet, growth was improved at all levels of date pits incorporated into the diets. Whole Zahdi dates, incorporated at 5, 10, and 30%, at the expense of corn, supported growth as efficiently as the control diets, but the incorporation of 47.7% of whole Zahdi dates as a total replacement of corn resulted in some growth depression and a slight decrease in feed utilization .Gross examination of various organs in both

feeding trials revealed no abnormalities. It is concluded that dates and date pits can contribute positively to the expanding poultry industry in the Arabian Gulf region where an overpopulation of dates occurs.

MAROUF, B.A. & ZEKI, L. Invertase from date fruits. Journal of Agricultural and Food Chemistry 1982, 30(5): 990-93. Nuclear Research Centre,Tuwaitha, Baghdad, Iraq.

Soluble and insoluble invertases were isolated from date fruits (Zahdi) after epicarp removal. The optimum temperature for both enzymes was 45°C. The optimum pH for soluble invertase was 3.6-4.8 and for insoluble invertase 3.6-4.2. Both enzymes had high affinity for their substrate, sucrose, with Km values of 3.12×10^{-3} mM and 4.35×10^{-3} mM for soluble and insoluble invertases, respectively. The specific activity of soluble invertase and of insoluble invertase was 40.2 μmol and 1.1 μmol (mg of protein)$^{-1}$ min -1, respectively. Sodium dodecyl sulphate inhibited both enzymes.

NIZAM EL-DIN, A.M. and ALI, L.M. Study on the pigment contents of some varieties of dates. Journal of Research for Agriculture and Water Resources, 1982, 1 (2): 1-6. (Ar. with Ar. & En. summs.). Agriculture and Water Resources Research Centre, Fadalyah, Baghdad, Iraq.

The investigation was conducted to study the pigment contents (as a source of colour and vitamins) of Zahdi, Sayer, Fursy, Maktoum, Braim, Barhi, Hallawi, Khadrawi, Ahmer Bazengany and Saada date varieties. The amounts of chlorophyll, carotenoids, anthocyanin and anthocyanidin were determined at some stages of maturity, particularly in Kimri and Khalal stages. High value of green, yellow and red pigments were present at Kimri stage in all the varieties. Sayer was found to contain the highest percentage of carotenoids (21.0 mg/100g) and chlorophylls (18.0 mg/100g) while highest percentage of red pigments was observed in Saada.

EL-SHURAFA, M. Y., AHMED, H.S. & ABOU-NAJI, S.E. Organic and inorganic constituents of date palm pit (seed). Date Palm Journal 1982. 1(2): 275-284 (En. with Ar. summ, 11 ref.).

The percentages of organic and inorganic constituents in the Taleese,

Adwi, Taghiat, Tasfert, Aspear and Seloudou date cultivars were (on average) as follows: starch 20.64, reducing sugars 2.4, non-reducing sugars 1.98, protein 6.43, oil 9.2, ash 1.2, Ca 0.038, K 0.244, P 0.112, Na 0.0082 and Cl 0.161. Other elements were: Fe 30.4 p.p.m., Mn 15.7 p.p.m., Zn 28.84 p.p.m. and Cu 8.1 p.p.m. The possibility of utilizing date seed components for fodder or industrial purposes is mentioned.

YOUSIF, A.K.; ALDDIN, S.M. and ALRIDA, H.A. Protein-rich food mixture for feeding infants and preschool children. Journal of Research for Agriculture and Water Resources, 1982, 1(2): 89-97. (En. with En. & Ar. summs.). Agriculture and Water Resources Research Centre, Fadalyah, Baghdad, Iraq.

Experiments were carried out to study the possibility of processing a protein rich food from local ingredients suitable for feeding infants and young children. The produced protein-rich foods which were designed as 'Tamrina' consist of about 50% wheat, 20% lentil, 10% chickpea, 10% dates and 10% milk powder. Nutritional evaluation of Tamrina revealed that these mixtures are of a high nutritive value containing appreciable amounts of essential vitamins, minerals and amino acids within the International Standard Limit. Organoleptic evaluation proved that Tamrina mixtures are equal if not superior to imported foods of the same type from the view point of nutritive value, appearance, colour, taste and flavour.

Entomology

ABDUL-AHAD, I. & JASSIM, H.K. The life cycle of *Parlatoria blanchardii* (Targ.) (Diaspididae, Homoptera). Arab Journal of Plant Protection 1983, 1(1): 22-24 (Ar. with En. summ.)

The life-cycle of *Parlatoria blanchardii* (Targ.) on date palm studied for 2 years, beginning in May 1978, revealed that it had 5 overlapping generations a year. First moult of all nymphs occurred at the same time on date palm leaves, however, the duration of instars varied according to the generation. After the first moult, the scale was green but later developed a black spot that was near the head region of the male scale but in the centre of the female scale.

MEYERDIRK, D.E. & HART, W.G. Survey of Auchenorrhyncha (Insecta: Homoptera) associated with the Canary Island date palm in Southern Texas. Florida Entomologist 1982, 65(3): 327-34.

The results are given of a survey of Auchenorrhyncha associated with Canary Island *Phoenix canariensis* in southern Texas, using yellow sticky traps, palm fronds coated with adhesive, vacuum sampling and visual collection. *Oliarus acicus* Caldwell was the most abundant species collected. *Myndus crudus* Van D., a suspected vector of lethal yellowing of coconut palms in Florida, was caught for the first time in Texas. These two cixiids and also *O. aridus* Ball are implicated as potential vectors of lethal yellowing of *P. canariensis* in Texas.

جدول 5

كفاءة بعض المبيدات الفطرية (تركيز 100 جزء بالمليون)
لحماية ثمار التمر من الاصابة بالفطر *Thielaviopsis paradoxa*

المبيدات	النسبة المئوية للاصابة على الثمار			المعدل
	المكرر الأول	المكرر الثاني	المكرر الثالث	
Benlate	صفر	صفر	صفر	صفر
Topsin-M	60	67	67	65
Bavistin	صفر	صفر	صفر	صفر
Homai	صفر	صفر	صفر	صفر
Botran	100	100	100	100
Control	100	100	100	100

جدول 4

فعالية بعض المبيدات الفطرية (تركيز 100 جزء بالمليون) في المختبر على الفطر *Thielaviopsis paradoxa*

المبيدات	قطر النمو الخضري (مم)			المعدل
	الأول	الثاني	الثالث	
Ronilan	65	50	75	63
Benlate	صفر	صفر	صفر	صفر
Dithane M-45	90	90	90	90
Topsin-M	صفر	صفر	صفر	صفر
Captan	90	90	90	90
Euparen	28	29	27	28
Bavistin	صفر	صفر	صفر	صفر
Homai	صفر	صفر	صفر	صفر
Antracol	85	85	79	83
Control	90	90	90	90

جدول 3

تأثير درجات الحرارة المختلفة على النمو الخضري للفطر

Thielaviopsis paradoxa

درجات الحرارة (م°)	قطر النمو الخضري للفطر (مم) في المكرر			المعدل
	الأول	الثاني	الثالث	
10	صفر	صفر	صفر	صفر
15	60	60	60	60
20	70	70	69	70
25	90	90	90	90
30	90	90	90	90
35	صفر	صفر	صفر	صفر

جدول 2
تأثير البيئات الغذائية المختلفة على النمو الخضري للفطر

Thielaviopsis paradoxa

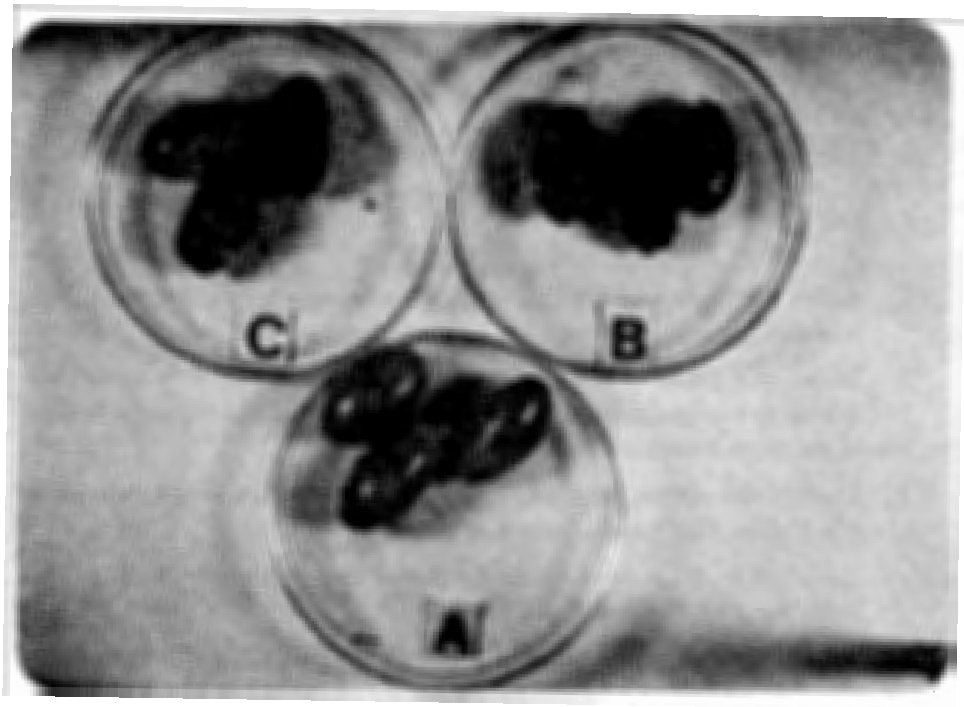
البيئة الغذائية	قطر النمو الخضري للفطر (مم) في المكرر			المعدل
	الأول	الثاني	الثالث	
Water agar	22.5	26.5	27.0	25.3
Czapekdox agar	40	42.5	38.5	40
Cornmeal agar	81.5	76.0	81.5	80.0
P.D. agar	90	90	90	90
Soyabean agar	90	90	90	90
Date extract +agar	90	90	90	90
Leaf extract +agar	90	90	90	90

جدول 1

حساسية ثمار بعض أصناف التمر للفطر *Thielaviopsis paradoxa*

في طوري نضجها الأخضر (الجمرى) والأصفر (الخلال)

الأصناف	النسبة المئوية للاصابة							
	الطور الأخضر الجمري				الطور الأصفر الخلال			
	مجروح ملوث	مجروح غير ملوث	غير مجروح ملوث	غير مجروح غير ملوث	مجروح ملوث	مجروح غير ملوث	غير مجروح ملوث	غير مجروح غير ملوث
خستاوي	89	صفر	صفر	صفر	44	صفر	صفر	صفر
زهدي	78	صفر	صفر	صفر	67	صفر	صفر	صفر
تبرزل	67	صفر	صفر	صفر	78	صفر	صفر	صفر
بربن	78	صفر	صفر	صفر	100	صفر	صفر	صفر
سكري	100	صفر	صفر	صفر	100	صفر	صفر	صفر



شكل 1 ، ثمار تمر (طور الجمري) ملوثة بسبورات الفطر
T. Paradoxa ومعاملة بالمبيدات
A بنليت B بوتران C مقارنة

أو ثمار النخيل على أن يستعمل بنفس التركيز الذي استعمل في هذه الدراسة 1 سم^3/ لتر ماء).

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4) اختبار فعالية بعض المبيدات الفطرية على النمو الخضري للفطر

لقد أظهرت نتائج هذه التجربة بأن جميع المبيدات الفطرية الجهازية شديدة الفعالية ضد هذا الفطر عدى المبيد توبسين حيث لم يشاهد أي نمو خضري للفطر على البيئات الغذائية الحاوية على أي منها خلال فترة الحضانة البالغة أربعة أيام وربما يرجع سبب عدم فعالية المبيد توبسين الى عدم التصاقه بثمار التمر عند رشه أو لتفاعله مع مكونات عصير الثمار عند تماسه بالجروح. أما المبيدات الفطرية غير الجهازية فقد تفاوتت بفعاليتها ضد الفطر وكان المبيد يوبارين أكثرها فعالية حيث كان نمو الفطر على البيئة الغذائية الحاوية عليه ضعيفاً بلغ 28 ملم خلال فترة الحضانة مقارنة بنموه الذي بلغ 90 ملم على البيئة الغذائية الخالية من المبيدات (مقارنة) وقد جاء المبيد رونيلان في المرتبة الثانية من حيث الفعالية حيث بلغ قطر النمو الخضري على البيئة الغذائية الحاوية عليه 63 ملم خلال نفس فترة الحضن أما بقية المبيدات (دايثين م ـ 45 وانتراكول وكابتان) فقد كانت إما ضعيفة التأثير كما هو الحال في الانتراكول أو عديمة التأثير كما هو الحال في مبيدي الدايثين م ـ 45 والكابتان. جدول (4).

5) اختبار كفاءة بعض المبيدات الفطرية في حماية ثمار التمر من الاصابة بالفطر.

إن نتائج التجربة الخاصة بكفاءة بعض المبيدات الفطرية في حماية ثمار التمر من الاصابة بالفطر قد جاءت مطابقة لنتائج التجربة السابقة حيث بقيت المبيدات المختبرة محافظة على فعاليتها ولم تلاحظ أية اصابة على الثمار الملوثة بسبورات الفطر والمرشوشة باحدى هذه المبيدات (جدول 5).

أما المبيد بوتران الذي أدخل في هذه التجربة للمقارنة فلم يظهر أية فعالية ضد هذا الفطر وقد وصلت نسبة اصابة الثمار المرشوشة به الى 100٪ كما هو الحال في الثمار غير المرشوشة بأي مبيد (مقارنة) جدول (4 و 5) وشكل (1) وعلى ضوء هذه النتائج فيمكن النصح باستعمال احدى هذه المبيدات لمقاومة الفطر على أزهار

الغذائيتين السابقتين. وربما يرجع سبب هذا الى عدم توفر المواد الغذائية الضرورية لنموه في هاتين البيئتين الغذائيتين وتوفرها في البيئتين السابقتين جدول (2).

وفيما يخص البيئات الغذائية الحاوية على عصير سعف أو ثمار التمر فقد بلغت من الجودة لنمو الفطر ما بلغته بيئتا عصير خلاصة البطاطا وفول الصويا حيث بلغ قطر النمو الخضري عليهما 90 مم خلال نفس فترة الحضانة مما يدل دلالة واضحة على أن عصير سعف أو ثمار النخيل يحتوي على جميع المواد الغذائية الضرورية لنمو هذا الفطر ويمكن أن تحل احدى هاتين البيئتين محل البيئات الغذائية الصناعية الغالية الثمن لزرعه وتنميته في المختبر في الدراسات القادمة عليه.

3) تأثير درجات الحرارة المختلفة على النمو الخضري للفطر

يظهر من الجدول (3) أن المدى الحراري الذي أمكن تنمية الفطر ضمنه كان ضيقاً انحصر بين درجة حرارة 15 - 30 °م .حيث لم يشاهد أي نمو خضري للفطر في درجات حرارية أوطأ من 10 °م أو أعلى من 35 °م في جميع التجارب التي جرت عليه خلال هذه الدراسة. مما يدل على أن الفطر يفضل درجات الحرارة المعتدلة ومما يؤكد ذلك أن الفطر قد نما بنشاط وبلغ قطر نموه نهاية الصحن (90 ملم) خلال فترة الحضانة البالغة 4 أيام عند وضعه في درجات حرارة معتدلة (25 و 30 م) بينما كان نموه ضعيفاً في درجات الحرارة الواطئة حيث لم يزد قطر نموه الخضري عن 60 ملم في درجة حرارة 15 °م وعن 70 ملم في درجة حرارة 20 °م خلال نفس فترة الحضانة ويمكن ربط تصرف هذا الفطر تحت ظروف المختبر بتصرفه في الطبيعة حيث لوحظ أن اصابة الأزهار أو الثمار بهذا الفطر تحدث عادة خلال شهري آذار ونيسان لأن معدل درجات الحرارة خلال هذين الشهرين في العراق تتراوح عادة بين 25 ـ 30 °م وهي ضمن المدى الحراري الملائم لنشاطه ونموه. وربما يعزى سبب قلة أو عدم اصابة بعض أصناف التمر به لأنها تكون الطلع بأوقات مبكرة لا يكون فيها الفطر نشطاً لانخفاض درجات الحرارة عن المدى الحراري.

النتائج والمناقشة

1) دراسة حساسية بعض أصناف التمر للفطر

لقد أظهرت نتائج تجربة حساسية ثمار التمر للفطر *Thielaviopsis paradoxa* بأن الفطر ضعيف التطفل ولا يمكن أن يحدث الاصابة على الثمار إلا بوجود الجروح بدلالة عدم حدوث أي اصابة على الثمار غير المجروحة رغم تلويثها بعالق سبورات الفطر بينما ظهرت الاصابة واضحة وعلى جميع أصناف التمر عند احداث الجروح فيها ورشها بعالق سبورات الفطر جدول رقم (1).

كما أن نسبة الاصابة بالفطر اختلفت تبعاً لصنف التمر وطور نضجه. فقد كان الصنف سكري شديد الحساسية للفطر بطوري الجمري والخلال بينما كان الصنف بربن حساساً للفطر في طور الخلال وأظهر بعض المقاومة له في طور الجمري. أما بقية الأصناف فقد كانت متوسطة الحساسية للفطر لكلا طوري نضجها ما عدا الصنف زهدي الذي أظهر مقاومة متوسطة في طور الجمري جدول رقم (1). وربما يعزى سبب هذا التفاوت في الحساسية بين الأصناف إلى وجود بعض المواد المشجعة أو المثبطة للفطر في عصيرها أو الى ارتفاع نسبة السكر في عصير بعض الأصناف وانخفاضه في عصير الأصناف الأخرى.

2) تأثير البيئات الغذائية الحاوية على عصير سعف أو ثمار النخيل على نمو الفطر

لقد أظهرت نتائج تجربة تأثير البيئات الغذائية على نمو الفطر بأن أحسن البيئات الغذائية لنموه هي البيئة الغذائية الحاوية على خلاصة عصير البطاطا المضاف اليه السكر أو الحاوية على خلاصة عصير فول الصويا حيث بلغ قطر النمو الخضري للفطر عليهما 90 مم خلال فترة الحضانة البالغة أربعة أيام. وقد جاءت البيئة الغذائية الحاوية على خلاصة عصير الذرة في المرتبة الثانية من حيث الجودة لنمو الفطر. أما البيئتين الباقيتين Czapek doxagar و Water agar فلم تكونا ملائمتين لنموه حيث كوّن الفطر عليهما نمواً ضعيفاً مقارنة بنموه على البيئتين

قطرها 9 سم بواقع 25 مل لكل صحن. وبعد تصلب البيئة الغذائية داخل الصحون زرع بأقراص من الآكر قطر 5 ملم حاوية على النمو الخضري للفطر ثم وضعت جميعها في حاضنة كهربائية على درجة 25 °م، وقد خصص لكل مبيد ثلاث صحون. وبعد مرور 4 أيام استخرجت الصحون من الحاضنة وقيس النمو الخضري للفطر فيها ثم قورن بنموه الخضري في الصحون الخالية من المبيدات الفطرية.

6) اختبار كفاءة بعض المبيدات الفطرية في حماية ثمار التمر من الاصابة بالفطر

لغرض التأكد من كفاءة المبيدات الفطرية التي أثبتت فعالية عالية ضد الفطر في المختبر فقد أعيد اختبار فعاليتها مرة أخرى على ثمار تمر ملوثة بجراثيم الفطر مع ادخال المبيد بوتران معها للمقارنة بالطريقة التالية:

جهز عدد ملائم من ثمار التمر صنف خستاوي في طور الجمري وبعد غسلها بالماء وتعقيمها بواسطة محلول الكلوراكس تركيز 10٪عمل في كل منها جرح صغير قرب منطقة الزهرة مستعملين لذلك سكين تشريح معقمة وبعد الانتهاء من عمل الجروح وضعت كل ثلاث ثمار في دورق زجاجي معقم ورشت بعالق سبورات الفطر تركيز 10^5 سبور/مل ثم وضعت الدوارق في حاضنة كهربائية على درجة 25 °م بعد شد أفواهها بصورة محكمة بواسطة قطع من النايلون المعقم. وفي اليوم الثاني استخرجت الدوارق جميعها ورشت الثمار الملوثة (ما عدا المقارنة) بالمبيدات المراد اختبار فعاليتها بتركيز 100 جزء بالمليون ثم أعيدت الدوارق بعد شد فوهتها بقطع النايلون الى الحاضنة وعلى نفس درجة الحرارة السابقة. وبعد مرور خمسة أيام استخرجت الدوارق من الحاضنة وفحصت الثمار وسجلت نسب الاصابة عليها.

التبخر. وبعد انتهاء فترة التحضين البالغة 4 أيام استخرجت الصحون جميعها وقيس قطر النمو الخضري للفطر في كل صحن.

5) اختبار فعالية بعض المبيدات الفطرية على النمو الخضري للفطر *T. Paradoxa*

انتخبت عشرة مبيدات فطرية واختبرت فعاليتها ضد الفطر أربعة منها جهازية هي:

1. Benlate (Methyl 1-(butylcarbamoyl)-2-benzimidazole carbamate.
2. Topsin-M 1,2-bis (3-methoxycarbomyl-2 thioureido) benzene.
3. Bavistin 2-(methoxycarbamoyl) benzimidazole.
4. Homai 1,2-bis (3-methoxycarbonyl-Zthioureido) benzene

وخمسة أخرى غير جهازية هي:

1. Ronilan 3-(3,5 dichlorophenyl) 5-ethenyl-5-methyl-2, 4 oxazolidine dione.
2. Dithane M-45 (Zinc + Manganese ethylonobis dithiocarbamate)
3. Captan
4. Euparen M.N-dichloroflmoromethylthio-N-N-dimethyl-N-(4 tolyl. sulfamide.
5. Antracol (Zinc-propylene bis-dithiocarbamate).

حضرت محاليل من كل من المبيدات أعلاه بتركيز 10٪ ثم أخذ من كل محلول 1 مل بواسطة ماصة زجاجية معقمة وأضيفت بصورة انفرادية الى دوارق زجاجية تحتوي كل منها على 100 مل بيئة غذائية (PDA) معقمة ومبردة الى 45 °م ليكون التركيز النهائي لكل مبيد فيها 100 جزء بالمليون. وقد ترك دورق واحد بدون اضافة أي مبيد اليه للمقارنة. ولغرض خلط المبيد بصورة جيدة مع البيئة فقد رجت الدوارق بلطف بواسطة اليد ثم صبت في صحون زجاجية معقمة

ومقارنة نموه عليها بنموه على البيئات الغذائية المستعملة في المختبر فقد اختير الصنف خستاوي وتم تحضير بيئتين غذائيتين منه بالطريقة الآتية:

أخذ 200 غرام من نسيج القمة النامية لسعفة حديثة التكوين و 200 غرام من ثمار التمر في طور الخلال، وبعد تقطيعها جيداً واضافة كمية مناسبة من الماء المقطر اليها سحقت كل منها على انفراد بواسطة جهاز الخلط (Blender) ثم رشح المحلول الناتج بواسطة قطع من الشاش. أضيف الى العصير الناتج كمية أخرى من الماء المقطر بحيث اصبح الحجم النهائي لكل محلول 1000 سم^3. ولأجل تحضير بيئة غذائية صلبة فقد أضيف الى كل من المحلولين 20 غرام من مادة الآكر ثم عقم المزيج بواسطة جهاز الأوتوكليف (التعقيم). وبعد الانتهاء من عملية التعقيم صب المحلول في صحون زجاجية معقمة وزرع بعد تصلبه بالفطر باستعمال اقراص امن الآكر قطر 1 سم حاوية على النمو الخضري للفطر، كما زرعت بنفس الطريقة اعداد مناسبة من الصحون الحاوية على بيئات غذائية اصطناعية مختلفة حضرت بالطرق الاعتيادية ثم وضعت جميع الصحون في حاضنة كهربائية على درجة حرارة 25 °م. وبعد مرور 4 أيام استخرجت الصحون جميعها وقيس قطر النمو الخضري للفطر فيها. وقد خصص للفطر في كل بيئة غذائية ما لا يقل عن ثلاثة صحون.

4) تأثير درجات الحرارة المختلفة على النمو الخضري للفطر

لغرض معرفة المدى الحراري الملائم لنمو الفطر فقد تم زرع عدد من الصحون الزجاجية الحاوية على بيئة غذائية اصطناعية (P.D.A.) بـه واستعملت لذلك أقراص من الآكر قطر 1 سم حاوية على نموه الخضري ثم حضنت الصحون جميعها في حاضنات ذات درجات حرارة مختلفة وانتخبت لذلك درجات الحرارة 10, 15, 20, 25, 30, 35° م. وقد غلفت الصحون التي وضعت في الحاضنات ذات الدرجات الحرارية العالية (30, 35° م) في أكياس من النايلون لتقليل عملية التبخر.

من نسيجها المصاب حديثاً ووضعه بعد تعقيمه بواسطة مادة الكلوراكس تركيز 10٪ في صحون زجاجية حاوية على بيئة غذائية صناعية (P.D.A) ثم وضع الصحون داخل حاضنة كهربائية على درجة حرارة 25° م. وبعد نمو الفطر بصورة نقية حول القطع المزروعة نقلت أجزاء صغيرة من أطراف نموه الخضري بواسطة ابرة معقمة الى عدد من أنابيب الاختبار الحاوية على نفس البيئة الغذائية السابقة ثم وضعت جميع أنابيب الاختبار في حاضنة على نفس درجة الحرارة أعلاه. وعند نمو الفطر داخل الأنابيب وتكوينه الجراثيم (Conidia) نقلت جميعها الى حاضنة أخرى ذات درجة حرارة 15 درجة مئوية وبقيت فيها لحين الاستعمال.

2) دراسة حساسية بعض أصناف التمر للفطر

تمت هذه الدراسة على خمسة أصناف من التمر هي: زهدي، خستاوي، بربن، سكري، تبرزل حيث أخذت كمية من الثمار من كل صنف في طور الخلال والجمري، وعقمت بمحلول الكلوراكس تركيز 10٪. وبعد تجفيفها من المحلول أحدث في قسم منها جروح متساوية الحجم قرب منطقة الزهرة باستعمال ابرة معقمة وترك قسم آخر بدون جروح. لوث قسم من الثمار (مجروح وغير مجروح) برشها بعالق سبورات الفطر تركيز 10^5 سبور/مل وترك قسم آخر من الثمار (مجروح وغير مجروح) بدون تلويث بل رش بماء معقم فقط لغرض المقارنة. وبعد الانتهاء من عملية التلويث وضعت كل ثلاثة ثمار في دورق زجاجي معقم شدت فوهته بصورة محكمة بقطعة من النايلون ثم وضعت جميع الدوارق الحاوية على الثمار في حاضنة ذات درجة حرارة 25 °م. أخذت النتائج بعد مرور 4 أيام حيث استخرجت الثمار وفحصت جميعها كل على انفراد ثم ثبتت نسبة الاصابة في كل صنف.

3) تأثير البيئات الغذائية الحاوية على عصير سعف وثمار النخيل على نمو الفطر

لغرض ملاحظة مدى اسناد عصير سعف وثمار النخيل للنمو الخضري للفطر

completely inhibited the growth at concentration of 100 ppm. Non systemic fungicides were different in their effectiveness. Euparen was the best followed by Ronilan. The remaining fungicides were either weak such as Antracol or had no effect on the fungus such as Dithane M-45 and Captan.

المقدمة

عـــــرف الفطـــــر (*Ceratocystis paradoxa* (Dade) C. Moreau.) كمسبب لمرض تعفن القمة النامية *Thielaviopsis paradoxa* (Deseyn) Hohn. في النخيل (المجنونة) منذ أمد بعيد (3) ولكن لم يشر الى وجوده كمسبب لهذا المرض في العراق إلا في سنة 1966 حيث ذكره لافيل Laville (6) وعزى تدهور وضعف كثير من أشجار النخيل في محافظة البصرة اليه.

إن هذا الفطر موجود في معظم الدول المنتجة للتمر. فقد ذكره فوست (3) Fawcett في تونس والجزائر وبراون وبهجت Brown and Bahgat (1) في مصر وكلوتز وفـوسـت Klotz and Fawcett (5) في الولايـات المتحـدة الأميركيـة ونكسن Nixon (7) في المملكة العربية السعودية وبرون ولافيل Brun and (3) Laville في موريتانيا. كما أشار اليه كل من ستريتز Streets (8) وفوست وكلوتز Fawcett and Klotz (4) كمسبب لمرض لفحة الأزهار في النخيل، ولكن لم يشر إليه كمسبب لمرض تعفن ثمار التمر في أي من الدراسات السابقة.

ونظراً لعزل هذا الفطر عدة مرات من ثمار تمر متعفنة في طور الجمري ولغرض التعرف على حياتيته وتحديد دوره في تعفن ثمار التمر فقد أجرى هذا البحث.

الطرق والمواد المستعملة

١) عزل الفطر بصورة نقية

عزل الفطر *T. paradoxa* من ثمار تمر مصابة (في طور الجمري) وردت الى مختبر مركز بحوث الوقاية من أحد بساتين محافظة ديالى وذلك بأخذ أجزاء صغيرة

كما أن البيئة الغذائية الحاوية على عصير سعف أو ثمار النخيل في طور الخلال قد بلغت من الجودة لاسناد نمو الفطر ما بلغته البيئتان السابقتان .

4 - إن جميع المبيدات الفطرية الجهازية شديدة الفعالية ضد هذا الفطر عدا المبيد توبسين م الذي اظهر فعالية متوسطة ضده . أما المبيدات الفطرية غير الجهازية فقد تفاوتت بفعاليتها وكان المبيد يوبارين أكثرها فعالية ضد الفطر وقد جاء المبيد رونيلان في المرتبة الثانية . أما بقية المبيدات فقد كانت إما ضعيفة التأثير كما هو الحال في المبيد انتراكول أو عديمة التأثير كما هو الحال في المبيدين كابتان ودايثين م - 45

BIOLOGY OF *THIELAVIOPSIS PARADOXA* AND ITS ROLE IN DATE FRUIT ROT

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ABSTRACT

This study was carried out in Plant Protection Research Department during the year 1982-1983 to elucidate the biology of the fungus *Thielaviopsis paradoxa* and to determine its activity in deteriorating the date palm fruits. Results revealed that *T. paradoxa* was a weak parasite; it can't infect the fruits unless wounds were available. All cultivars (Zahdi, Khistawi, Barban, Tabarzal, Sokkari) were infected but the percentage of infection was different depending on cultivars and stage of fruits maturation. Sokkari was very susceptible at Khalal and Chimri stages whereas, Barban was susceptible to the fungus at Khalal stage but tolerant at Chimri stage. *T. paradoxa* grew within a narrow range of temperature and was unable to grow at temperature higher than 30°C or below 15°C. The best media for mycelial growth were potato dextrose agar or soyabean agar. Water agar medium containing date palm leaves or fruits extract also supported good growth.

Experiment on the effect of fungicides showed that with the exception of Topsin-M, all systemic fungicides were effective against the fungus. They

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الفطر *Thielaviopsis paradoxa* (Deseyn) HOHN
حياتيته ودوره في تعفن ثمار التمر

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مركز بحوث الوقاية ـ الهيئة العامة للبحوث الزراعية التطبيقية،
أبو غريب بغداد ـ العراق.

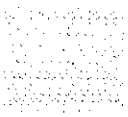
الخلاصة

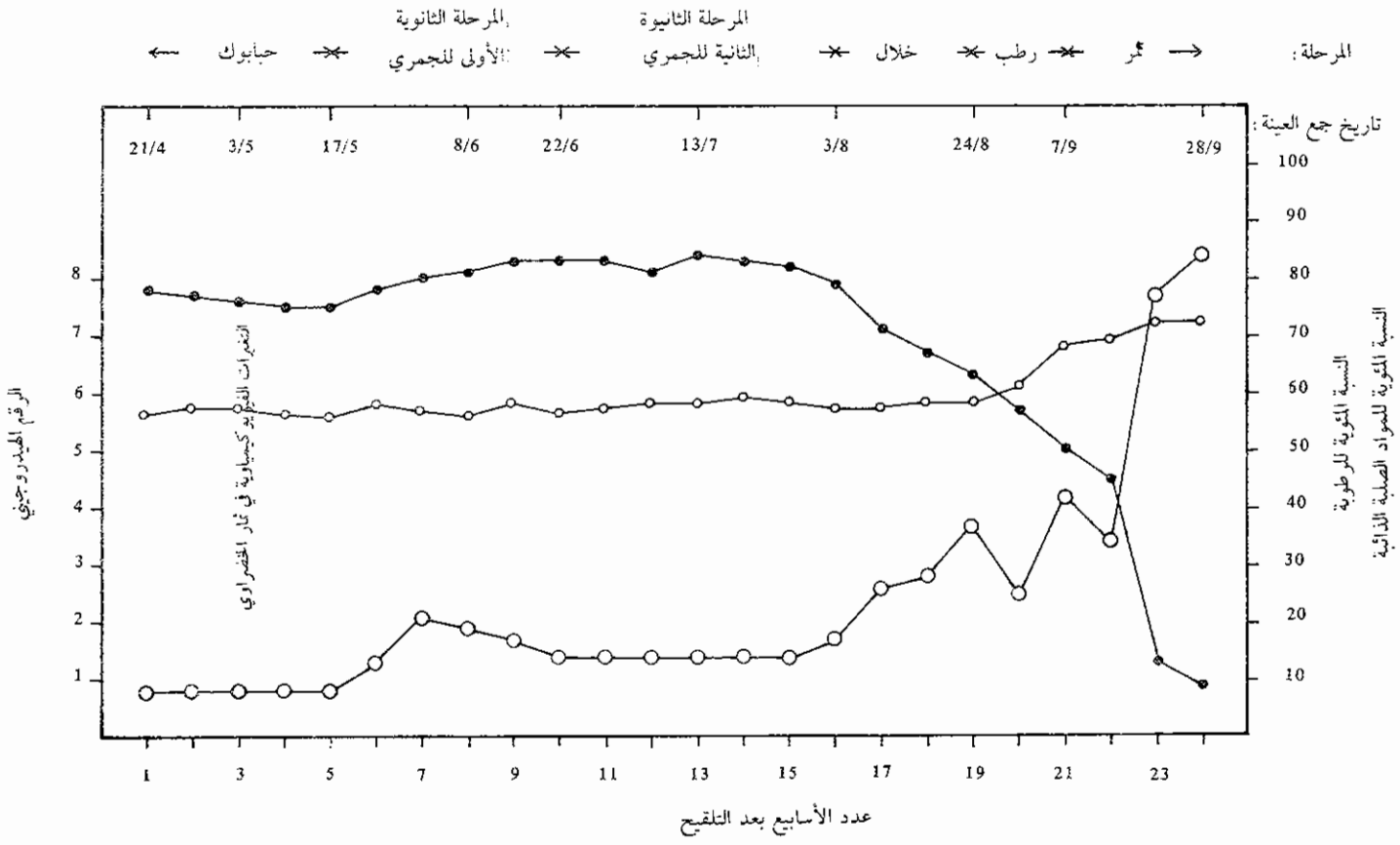
نفذ هذا البحث في مركز بحوث الوقاية في أبي غريب خلال الفترة - 1982 1983 للتعرف على حياتية الفطر *Thielaviopsis paradoxa* وتحديد دوره في تعفن ثمار التمر وقد أظهرت نتائج هذا البحث ما يلي:

1 ـ إن الفطر *T. paradoxa* ضعيف التطفل ولا يمكن أن يحدث الاصابة على ثمار التمر إلا بوجود الجروح. كما أن الفطر تمكن من اصابة جميع أصناف التمر المختبرة (زهدي، خستاوي، بربن، تبرزل، سكري) ولكن بدرجات مختلفة تبعاً للصنف وطور نضجه. فقد كان الصنف سكري شديد الحساسية لهذا الفطر بطوري نضجه الجمري والخلال بينما كان الصنف بربن حساساً للفطر في طور الخلال وأظهر بعض المقاومة له في طور نضجه الجمري.

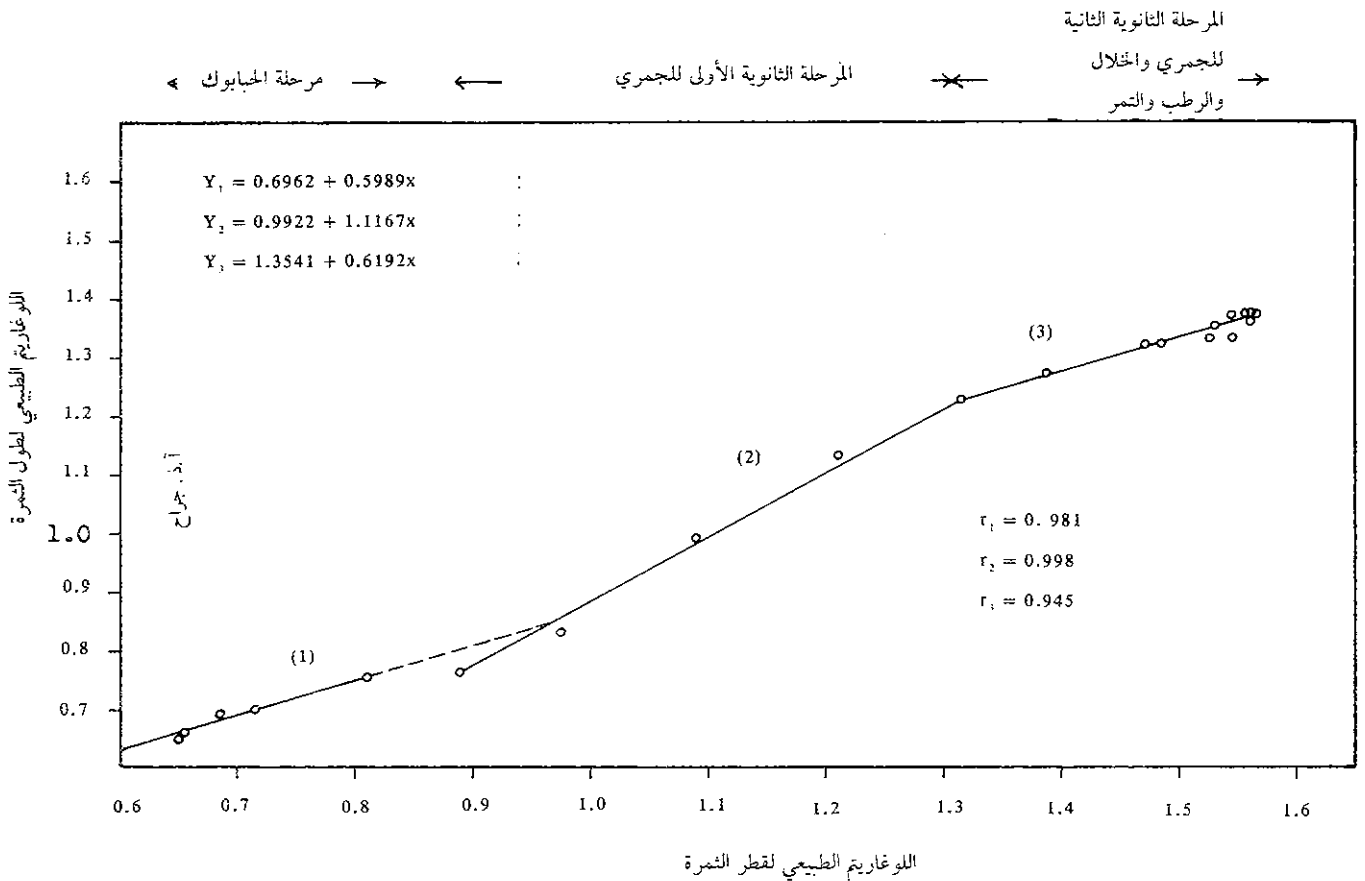
2 ـ إن المدى الحراري الذي أمكن تنمية الفطر ضمنه كان ضيقاً انحصر بين درجة حرارة15 – 30°م ولم يشاهد أي نمو للفطر في درجات حرارية أوطأ من 15° م أو أعلى من 30° م خلال هذه الدراسة.

3 ـ إن أحسن البيئات الغذائية لنمو الفطر هي البيئة الغذائية المكونة من خلاصة عصير البطاطا المضاف اليها السكر أو الحاوية على خلاصة عصير فول الصويا

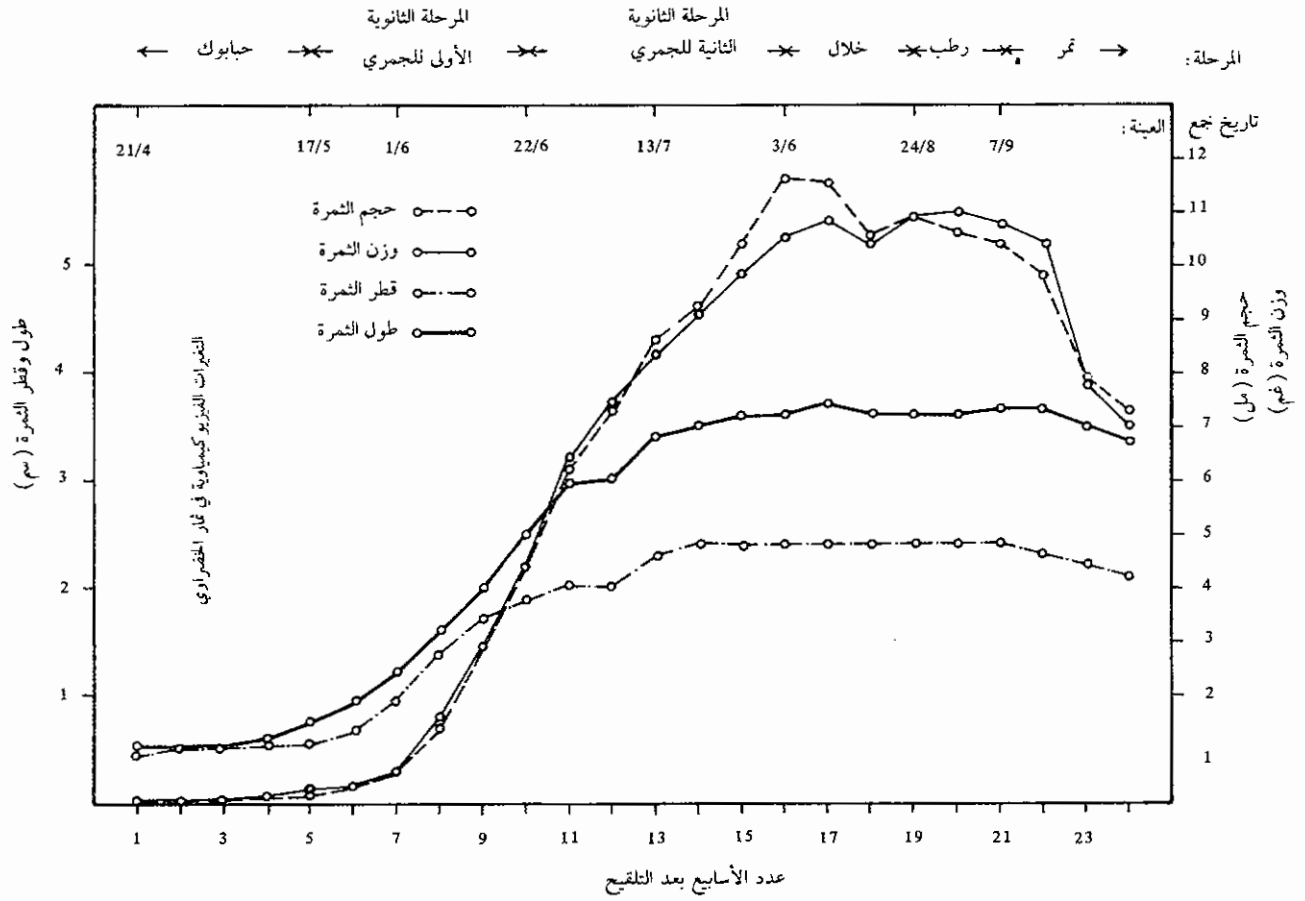




شكل رقم (3): التغييرات في النسبة المئوية للرطوبة (| ●——●) والرقم الهيدروجيني (o——o) والنسبة المئوية للمواد الصلبة الذائبة (o—○—o) خلال مراحل النضج المختلفة.



شكل (2): العلاقة الالومترية بين قطر وطول الثمرة خلال مراحل النمو والنضج المختلفة



شكل رقم (1): التغييرات في طول وقطر ووزن وحجم الثمار خلال مراحل النضج المختلفة

تابع جدول ١

المرحلة	المعدل النسبي الاسبوعي للزيادة في الطول ملم/ ملم اسبوع	المعدل النسبي الاسبوعي للزيادة في الطول ملم/ ملم اسبوع	معامل الثمرة	المعدل النسبي الاسبوعي للزيادة في الوزن غم/ غم/اسبوع	المعدل النسبي الاسبوعي للزيادة في الحجم سم ^{3}/سم ^{3} اسبوع
رطب	0.003–	0.006	1,521	0.001	0.001
	0.007–	0.006–	1.520	——	0,001–
تمر	0.012	0.003–	1.543	——	0.001
	0.003	0.026–	1,587	0.001–	0.001–
	0.042–	0,055–	1.608	0.005–	0.004–
	0.043–	0.019–	1,570	0.001–	0.001

جدول 2

المعدل النسبي للزيادة في طول وقطر ووزن وحجم الثمرة للمراحل الرئيسة من نموها

المرحلة	المعدل النسبي للزيادة في الطول ملم/ ملم اسبوع	المعدل النسبي للزيادة في القطر ملم/ ملم اسبوع	المعدل النسبي للزيادة في الوزن غم/ غم اسبوع	المعدل النسبي للزيادة في الحجم سم ^{3} سم ^{3} اسبوع
حبابوك	0,093	0,060	0,159	0,205
المرحلة الثانوية الأولى للجمري	0,245	0,267	0,737	0,730
المرحلة الثانوية الثانية للجمري	0,077	0,046	0,161	0,177
خلال	0,002	0,004–	0,015	0,051–
رطب	0,007–	0,006–	0,006	0,025–
تمر	0,027–	0,033–	0,144–	0,117–

جدول 1

المعدل النسبي الاسبوعي للزيادة في طول وقصر ووزن الثمرة
ومعامل الثمرة خلال المراحل المختلفة للنمو والنضج

المرحلة *	المعدل النسبي الاسبوعي للزيادة في الطول ملم/ ملم اسبوع	المعدل النسبي الاسبوعي للزيادة في الطول ملم/ ملم اسبوع	معامل الثمرة	المعدل النسبي الاسبوعي للزيادة في الوزن غم/ غم/اسبوع	المعدل النسبي الاسبوعي للزيادة في الحجم سم ^{3}/سم ^{3} اسبوع
حبابوك	0.011	0.028	0,976	0.028	0.032
حبابوك	0.072	0,073	0,976	0.061	0,069
حبابوك	0.066	0,012	1,029	0.007	0.007
حبابوك	0.222	0,128	1.131	**0,041**	0,041
المرحلة الثانوية	0.183	0,016	1.336	0.020	0.020
الأولى للجمري	0.192	0,163	1.376	0.044	0,041
	0.271	0,363	1,256	0.050	0,051
	0.277	0,327	1,194	0.046	0,045
	0,242	0.213	1.228	0.033	0,034
المرحلة الثانوية	0.165	0,101	1.310	0.019	0,019
الثانية للجمري	0.194	0.114	1.420	0.015	0,015
	0.034		1.47	0.005	0,006
	0.096	0,081	1.492	0.004	0,006
	0.042	0,037	1,500	0.003	0,002
	0.018	0,001	1.526	0.002	0.003
خلال	0.008	0.015	1,514	0,002	0.003
	0.011	0.007–	1.543	0.001	
	0.006–	0.002–	1.511	0.001–	0.002–

★ من الاسبوع الأول بعد التلقيح وحتى نهاية مرحلة التمر.

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وترتفع قليلاً خلال الأسبوعين التاليين، حتى بداية مرحلة الثانوية الثانية للجمرى، حيث وصلت الى 14٪وبقيت ثابتة خلال هذه المرحلة، ثم ارتفعت واستمرت بالارتفاع حتى نهاية مرحلة التمر، حيث بلغت 84٪عند جني الثمار شكل (3). وقد حصل (3) على نتائج مشابهة الى حد ما في السلالتين زهدي وساير.

وعلى ضوء ما تقدم، فان الفترة التي لوحظ فيها ثبوت في نسبة المواد الصلبة الذائبة، والتي تمثل المرحلة الثانوية الثانية للجمرى تقريباً، تمثل مرحلة الخمول النسبي للسلالة خضراوي.

وقد كانت هذه الفترة متوافقة مع تغير لون الثمار من الأخضر الغامق الى الأخضر المصفر قليلاً، مما يمكن اتخاذه كدليل تقريبي لتحديد بدء فترة الخمول النسبي.

وقطر ووزن وحجم الثمرة، فانها تكون خلال المرحلة الثانوية الثانية للجمرى، حيث تنخفض المعدلات النسبية للنمو بشكل واضح عما هي عليه في المرحلة السابقة.

4 . النسبة المئوية للرطوبة

تبدأ الرطوبة مرتفعة في بداية النمو، وتستمر حتى تبلغ أقصاها في المرحلة الثانوية الثانية للجمرى (شكل 3) يلي ذلك هبوط بطيء حتى بداية مرحلة الخلال، حيث يزداد معدل انخفاض الرطوبة تدريجياً حتى نهاية مرحلة الرطب، وتستمر بالانخفاض حتى تصل الى ما يقارب 9٪عند جني الثمار. وتتفق النتائج السابقة مع النتائج المستحصلة للسلالة دقلة نور (7, 6) والسلالتين زهدي وساير (3).

5 . الرقم الهايدروجيني

لوحظ أن الرقم الهايدروجيني يتراوح بين 5,6 و5,8 ابتداءاً من الأسبوع الأول بعد التلقيح، وحتى نهاية مرحلة الخلال (شكل 3) ثم ارتفع بسرعة الى 6.8 في نهاية مرحلة الرطب واستمر حتى وصل الى 7.2 في نهاية مرحلة التمر.

وتتوافق هذه النتائج مع ما حصل عليه (12, 11, 10, 9) من أن القيمة العالية للرقم الهايدروجيني ترافق النوعيات الجيدة من التمور، كما أشار (3) إلى أن الرقم الهايدروجيني للسلالة ساير كان أعلى منه للسلالة زهدي، في جميع مراحل النمو والنضج. حيث أن الأولى تعتبر من الأصناف الجيدة مقارنة بالثانية وأن ارتفاع قيمة الرقم الهايدروجيني في السلالة المدروسة تؤكد أن الأنواع الجيدة من التمور هي تلك التي لها رقم هايدروجيني أكثر من 6.

6 . المواد الصلبة الذائبة الكلية

تبقى نسبة المواد الصلبة الذائبة الكلية ثابتة تقريباً خلال مرحلة الحبابوك،

وتستمر الزيادة في الحجم حتى بداية مرحلة الخلال، حيث يبدأ الحجم بالتناقص التدريجي، بينما يبقى الوزن ثابتاً تقريباً، حتى بداية مرحلة التمر، يتبعها هبوط سريع في كليهما، يستمر حتى موعد جني الثمار وهذه النتيجة تشابه الى حد كبير ما حصل عليه في السلالتين زهدي وساير (5).

إن ظاهرة استمرار الزيادة في حجم الثمار مع ثبات الوزن، قد تعود الى حدوث زيادة مستمرة في سمك طبقتي الميزوكارب الداخلية والخارجية، على السواء، حتى منتصف مرحلة الخلال، حيث تتسع المسافات البينية دون حصول زيادة في عدد الخلايا (4).

ويتضح من نتائج دراسة التغيرات في طول وقطر ووزن وحجم الثمرة والموضحة بالشكل (1) أن طراز نمو الثمرة من النوع الأسي Exponentral growth إذ يأخذ المنحني شكل الحرف S single sigmoid curve، حيث يكون النمو بطيئاً في المراحل المبكرة، يأخذ بعدها بالزيادة السريعة، ويستمر لفترة معينة ثم يتوقف، يتبعه هبوط تدريجي.

3. المعدل النسبي للزيادة في طول وقطر ووزن الثمار خلال المراحل الرئيسية للنمو والنضج.

يظهر من الجدول (2) أن أقصى معدل نسبي للزيادة في الصفات الأربعة المدروسة يكون خلال المرحلة الثانوية الأولى للجمرى، ثم ينخفض خلال المرحلة الثانوية الثانية للجمرى، ويستمر بالانخفاض حتى نهاية مرحلة نضج الثمار. كما أن هناك توافقاً في معدلات الزيادة في وزن وحجم الثمار خلال مرحلة الحبابوك والمرحلتين الثانويتين للجمرى، بينما يلاحظ هبوطاً في المعدل النسبي للزيادة في الوزن عن المعدل النسبي للزيادة في الحجم وذلك خلال مرحلتي الخلال والرطب، يتبعه توافقاً في المعدل النسبي للزيادة في كل منهما خلال مرحلة التمر.

ولدى محاولة تحديد فترة الخمول النسبي على ضوء نتائج التغيرات في طول

إن لدراسة التغيرات في طول وقطر الثمرة في السلالات المختلفة، أهمية تصنيفية، إذ لها علاقة وطيدة بشكل الثمرة. فارتفاع قيمة معامل الثمرة عن واحد، يدل على أن طول الثمرة يفوق قطرها، وبالتالي فان شكل الثمرة يكون متطاولاً، بينما يدل انخفاضه على أنها أقرب الى الشكل الكروي.

لقد اتضح من دراسة العلاقة الالومترية Allometric relationship بين قطر وطول الثمرة، حيث اعتبر لوغاريتم قطر الثمرة متغيراً معتمداً، ولوغاريتم طولها متغيراً مستقلاً، ان هناك ثلاث مراحل للنمو. وقد استخدمت طريقة Least square في ايجاد معادلة الخط المستقيم الذي يمثل كل مرحلة من المراحل الثلاث (شكل 2) والتي تمت باستخدام الحاسبة الالكترونية. وحيث أن قيمة المعامل الالومتري في المعادلة الأولى أقل من واحد (0.5989) فان العلاقة الالومترية بين قطر وطول الثمرة في المرحلة الأولى من النمو سالبة، مما يدل على أن معدل النمو النسبي للقطر أقل منه للطول. وفي المعادلة الثانية، كانت العلاقة ايسومترية، حيث قيمة K مساوية الى واحد (1,1167) أما في المعادلة الثالثة فكانت سالبة.

إن هذه النتائج تخالف تلك المستحصلة من دراسة العلاقة الالومترية بين طول وقطر ثمار الزهدي (2). والسبب يعود الى اختلاف السلالات عن بعضها في الصفات الطبيعية، مما قد يكون له دلالات لتميز السلالات عن بعضها البعض.

2. وزن وحجم الثمرة

أظهرت دراسة التغيرات في وزن الثمرة وحجمها خلال المراحل المختلفة من نموها (شكل 1)، أن هناك توافقاً في الزيادة في كليهما، ابتداءاً من الأسبوع الأول بعد التلقيح، وحتى الأسبوع الرابع للمرحلة الثانوية الثانية للجمرى، حيث لوحظت زيادة في حجم الثمرة، تفوق الزيادة الحاصلة في وزنها. ويتضح ذلك من ملاحظة التغيرات في المعدل النسبي الأسبوعي للزيادة في كل منهما (جدول 1).

هاون خزفي، ثم عين الرقم الهايدروجيني باستخدام جهاز Pye-Unicam-Philips pH-meter.

6. تقدير النسبة المئوية للمواد الصلبة الذائبة الكلية

وضعت عشرة غرامات من الثمار المقطعة داخل طبقة مزدوجة من قماش الشاش ودقت بهاون خزفي لاستخراج عصير الثمار (7) حيث قيس محتوى العصير من المواد الصلبة الذائبة الكلية باستعمال جهاز Abbe-refractometer.

النتائج والمناقشة

قسمت مرحلة الجمرى الى مرحلتين ثانويتين نتيجة لوجود اختلافات واضحة بينهما وعلى أساس تغير اللون من الأخضر الغامق الى الأخضر المصفر.

1. طول وقطر الثمرة والعلاقة الالومترية بينهما

إن دراسة التغيرات الحاصلة في طول وقطر الثمرة خلال المراحل المختلفة لنموها (شكل 1) قد اظهرت أن أقصر طول بلغته الثمار هو 36.8 ملم تقريباً، خلال الأسبوع الثاني لمرحلة الخلال، بينما بلغ أقصى قطر ما يقارب 24 ملم في الأسبوع الأول من المرحلة المذكورة. وكان أقصى معدل نسبي اسبوعي للزيادة في طول وقطر الثمرة (جدول 1) في الأسبوع الرابع للمرحلة الثانوية الأولى للجمرى، والأسبوع الثالث للمرحلة المذكورة، على التوالي. ويتوافق الهبوط في المعدل النسبي للزيادة في الطول والقطر مع بداية فترة الخمول النسبي.

وتصل قيمة معامل الثمرة الى واحد تقريباً (تساوي الطول والقطر) في الأسبوع الثالث لمرحلة الحبابوك.

وهذه النتائج تخالف ما حصل عليه في السلالتين زهدي وساير، حيث وصل معامل الثمرة الى واحد تقريباً في الأسبوع الأول لمرحلة الجمرى، والأسبوع الرابع منها، على التوالي (5).

ثمرة من كل نخلة، وحسب الحجم الكلي للثمرة بواسطة اسطوانة مدرجة والماء المقطر المزاح، لمعدل ثلاثين ثمرة من كل نخلة.

3. المعدل النسبي للزيادة في طول وقطر ووزن وحجم الثمرة

Relative growth rate

حسب المعدل النسبي للزيادة في كل صفة لكل أسبوع باستعمال معادلة يلاكمان (8).

$$r = \frac{LnXt - LnXo}{t}$$

حيث:

r = المعدل النسبي للزيادة في الصفة المدروسة

LnXo = قيمة اللوغاريتم الطبيعي للصفة المدروسة في بداية النمو.

LnXt = قيمة اللوغاريتم الطبيعي للصفة المدروسة في نهاية الفترة الزمنية المراد استخراج قيمة r فيها.

t = الزمن.

4. تقدير نسبة الرطوبة

وزنت خمس غرامات من عينة الثمار المأخوذة بصورة عشوائية بعد تقطيعها وإزالة البذرة، ووضعها في اطباق صغيرة. ثم جففت في فرن مخلخل الضغط VacuumOven بدرجة حرارة 65 م وضغط 30 ملم زئبق (7) لمدة لا تقل عن 18 ساعة. ثم أعيد وزن الاطباق ثانية وحسبت النسبة المئوية للرطوبة كما يلي:

$$100 - \frac{\text{الوزن الجاف}}{\text{الوزن الرطب}} \times 100 \ldots .$$

5. تعيين الرقم الهايدروجيني

سحقت عشرة غرامات من الثمار المقطعة، مع عشر ملليترات من الماء المقطر في

البصرة، سوى أن ثمار الأول أكبر قليلاً، وميل اللون الأصفر للأخضر في مرحلة الخلال أشد مما في الثاني. إن محصول خضراوي بغداد أكثر من خضراوي البصرة، وهو يقارب محصول الزهدي في الكمية، كما أن نضج الأول يعتبر متأخراً بالنسبة لنضج الثاني (1).

ولقد شملت الدراسة الحالية التغيرات في قطر وطول وحجم ووزن الثمرة خلال المراحل الخمس للنمو والنضج وهي: الحبابوك والجمرى والخلال والرطب والثمر.

المواد وطريقة العمل

اختيرت ثلاث من أشجار النخيل للسلالة الزراعية خضراوي في محطة الأبحاث التابعة للهيئة العامة للبستنة والغابات في الزعفرانية/بغداد، مع الأخذ بنظر الاعتبار التناسق في العمر والنمو وكافة المعاملات الزراعية، ولقحت باللقاح المختلط، في منتصف شهر نيسان 1975. وجمعت عينات عشوائية اسبوعياً، منذ الأسبوع الأول بعد التلقيح وحتى نهاية مرحلة النضج. واستخدمت العينات المجموعة لدراسة الجوانب التالية:ـ

1. قياس طول وقطر الثمرة

أخذت القياسات لخمس عشرة ثمرة من كل نخلة، مختارة بصورة عشوائية باستعمال القدمة Vernier درجة الضبط 0.1 ملم، وقدر معدل طول وقطر الثمرة خلال المراحل المختلفة من نموها على أساس المعدل العام لخمس وأربعين ثمرة، استناداً الى عدم وجود فرق احصائي بعد التحليل احصائياً في معدل هذه القياسات بين النخلات الثلاث.

2. تقرير وزن وحجم الثمرة

قدر الوزن الكلي للثمرة باستعمال ميزان حساس من نوع Metler لمعدل ثلاثين

مقدمة

إن للتغيرات التي تحدث خلال مراحل نمو ونضج الثمار أهمية مورفولوجية وفسيولوجية وبايوكيمياوية، إذ أنها تحدد مظهر ولون وطعم ورائحة ومكونات الثمار، وبالتالي قيمتها الغذائية، علاوة على أهمية التغيرات في وزن وحجم الثمار، وعلاقتها بالانتاج. وقد جرى الاهتمام باجراء مثل هذه الدراسات على العديد من ثمار النباتات، كما أجريت عدة دراسات لبعض التغيرات في بضعة أصناف من نخيل التمر. درست التغيرات في طول وقطر ووزن وحجم ثمار السلالة دقلة نور (6) والسلالتين زهدي وساير (5)، والعلاقة الالومترية بين قطر وطول الثمرة في السلالة زهدي (5) (2)، كما درست التغيرات في النسبة المئوية للرطوبة في السلالتين برحي ودقلة نور (9) والسلالة دقلة نور (6) و (7) والسلالتين زهدي وساير (3). وجرى تعيين الرقم الهايدروجيني pH خلال المراحل المختلفة من النمو في السلالتين برحي **ودقلة** نور (12, 11, 10, 9) والسلالتين زهدي وساير (3) وكذلك التغيرات في النسبة المئوية للمواد الصلبة الذائبة الكلية خلال مراحل النمو في ثمار السلالة دقلة نور (13) والسلالتين برحي ودقلة نور (9) والسلالة دقلة نور (7). ولم تشر جميع الدراسات الى وجود فترة ثبوت في النسبة المئوية للمواد الصلبة الذائبة الكلية في الأصناف المدروسة، غير أنه لوحظت هذه الظاهرة في ثمار السلالتين زهدي وساير (3).

إن الدراسات سابقة الذكر لم تتناول السلالة خضراوي، رغم أهميتها التجارية، إذ أنها احدى السلالات الأربعة التجارية المهمة في العراق، وعليه فقد احتيرت لهذه الدراسة. وقد تناولت الدراسة سلالة خضراوي بغداد، الذي تنتشر زراعته في المنطقة الوسطى من العراق، والذي يختلف عن سلالة خضراوي البصرة، المنتشرة زراعته في المنطقة الجنوبية، بوجود فروق واضحة في المظهر العام للنخلة. أما تمر خضراوي بغداد تام النضج، فلا يكاد يفرق عن تمر خضراوي

آ.ذ. جراح

انخفضت معدلات النسبة للزيادة في الصفات المدروسة مع ثبوت النسبة المئوية للمواد الصلبة الذائبة الكلية.....

SOME PHYSICO-CHEMICAL CHANGES IN KHADRAWI DATE FRUITS AND THE DETERMINATION OF DEPRESSED PERIOD

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ABSTRACT

Changes in length, diameter, weight, volume, total soluble solids, moisture content & pH of the fruit were studied weekly, through-out the different stages of growth and development. Results had shown that at the begining of the growth, fruit diameter was larger than length, but length increased afterwards, and the fruit index (Length/Diameter) approaches unity at the end of hababuk stage and increases later. The allometric relationship between diameter and length revealed three main phases of development. There was a parallel increase in weight and size from the begining of hababuk up to the middle of the secondary second chemri, after which fruit increased in size more rapidly than in weight. The development of fruit showed a single sigmoid curve, indicating an exponential growth pattern. Moisture percentage reached its maximum during the middle of secondary second chemri stage and decreased gradually till the harvest season. Percentage of total soluble solids remain almost stable through-out secondary second chemri, increases gradually till the end of ripening. pH was found to be high in the cultivar under study. The depressed period of growth was delimited by secondary second chemri, during which relative growth rates decreased and total soluble solids percentage remained relatively stable, while colour changed from dark green to yellowish green.

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بعض التغيرات الفيزيوكيمياوية في ثمار الخضراوي وتحديد فترة الخمول النسبي*

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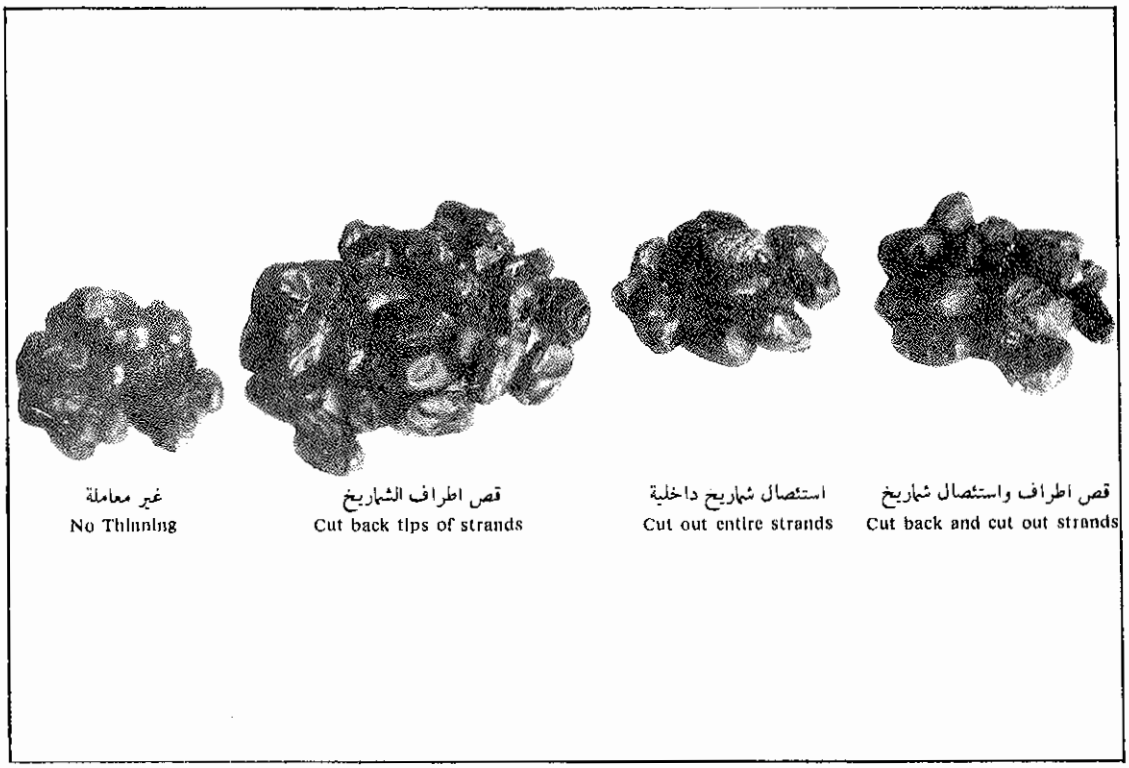
الخلاصة

درست التغيرات في طول وقطر ووزن وحجم الثمرة، المواد الصلبة الكلية الذائبة، المحتوى الرطوبي والرقم الهايدروجيني لها اسبوعياً، خلال المراحل المختلفة للنمو والنضج. وجد أن قطر الثمرة يكون أكبر من طولها في بداية النمو، إلا أن الطول يزداد بعد ذلك، وقد بلغ معامل الثمرة (الطول/القطر) واحد تقريباً في نهاية مرحلة الحبابوك، واستمر بالارتفاع حتى نهاية مرحلة التمر. واظهرت دراسة العلاقة الالومترية بين القطر والطول وجود ثلاث مراحل رئيسية للنمو. وتبين أن هناك توافقاً في الزيادة بين وزن وحجم الثمرة، منذ بداية الحبابوك وحتى منتصف المرحلة الثانوية الثانية للجمري، حيث يزداد الحجم بعدها بسرعة تفوق سرعة زيادة الوزن. ان طراز نمو الثمرة من النوع الاسي. وبلغت النسبة المئوية للرطوبة أقصاها في منتصف المرحلة الثانوية الثانية للجمرى، ثم انخفضت تدريجياً حتى جني الثمار. ولوحظ ثبات في النسبة المئوية للمواد الصلبة الذائبة الكلية خلال المرحلة الثانوية الثانية للجمرى. كما لوحظ ارتفاع قيمة الرقم الهايدروجيني للسلالة المدروسة.

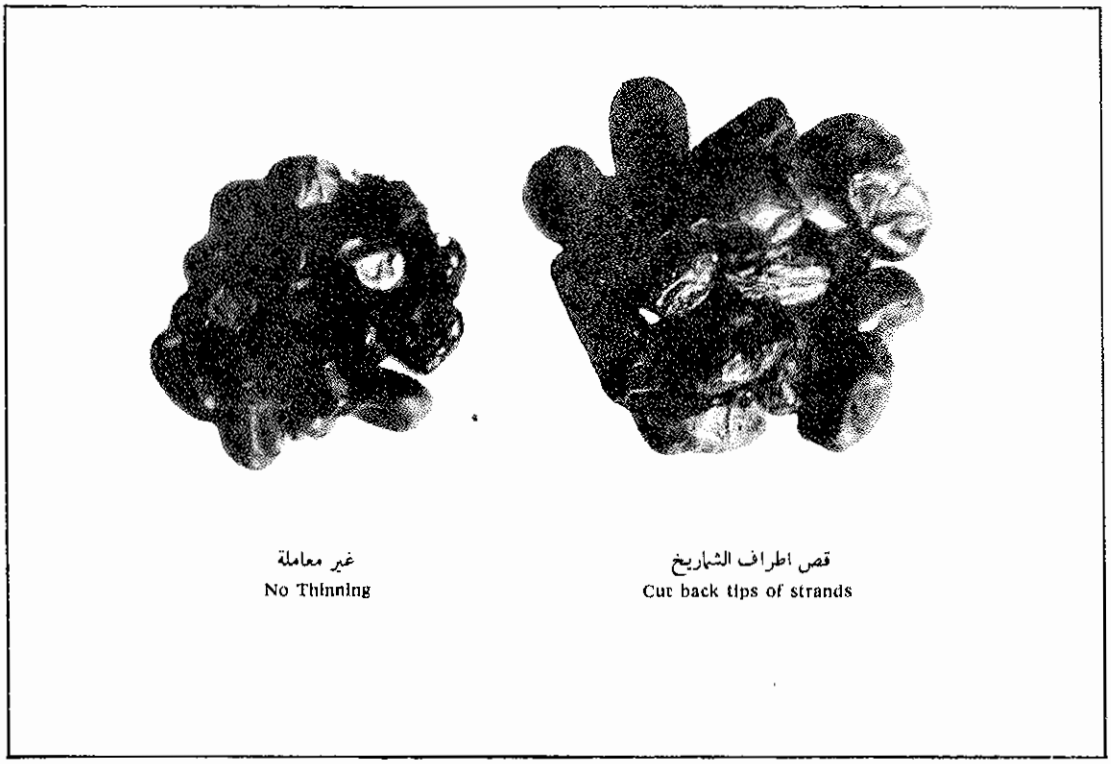
وقد اعتبرت المرحلة الثانوية الثانية للجمرى فترة الخمول النسبي حيث

* جزء من رسالة ماجستير



صورة رقم (2)

اثر طرق خف ثمار الخستاوي على حجم ومظهر الثمار



صورة رقم (1)
اثر خف ثمار الخستاوي على حجم الثمار

جدول رقم (2)

* تأثير عمليات خف الثمار على انتاج الخستاوي 1983

المعاملات	متوسط وزن العذق (كيلوجرام)	الانتاج المتوقع للنخلة (كيلوجرام)	متوسط وزن الثمرة (جرام)	نسبة الثمار من الدرجات (أ و ب)	الرطوبة ٪	نسبة المواد الصلبة الذائبة	الرقم الهايدروجيني	نسبة السكريات المختزلة	نسبة السكريات الكلية
(1) مقارنة (بدون خف)	7.0	56.0	7.8	50	17.1	61	5.2	34.0	46.0
(2) قص أطراف الشماريخ (خف30٪)	5.2	41.6	9.0	65	15.3	67	5.2	39.9	51.5
(3) ازالة شماريخ داخلية (خف 30٪)	4.5	36.0	8.3	40	13.0	69	6.4	43.5	54.9
(4) قص أطراف الشماريخ وازالة شماريخ داخلية (خف36٪)	4.2	33.6	8.1	30	13.1	68	6.5	34.5	53.5
F	* *		*						

★ على اساس الوزن الطازج

جدول رقم (1)

اثر خف ثمار الخستاوي على انتاج النخيل والصفات الثمرية في الزعفرانية 1982

المعاملة	متوسط الثمار	حجم (سم)		متوسط وزن الثمرة (جرام)	متوسط وزن البذرة (جرام)	متوسط انتاج النخلة (كيلو جرام)
	الطول	العرض				
(1) مقارنة بدون خف	3.0	2.2		7.4	.66	22.5
(2)قص اطراف الشماريخ خف 30٪	3.3	2.4		9.1	.62	18.5
(3) ازالة شماريخ داخلية خف 25٪	3.1	2.3		6.9	.65	19.0
(4) قص أطراف الشماريخ مع ازالة عذوق كاملة خف 36٪	3.4	2.4		7.8	.58	18.0
(5) ازالة عذوق كاملة	2.8	2.2		6.6	.62	20.0

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عملية ازالة الشماريخ الوسطية في تجربة عام 1983 في جفاف الثمار في طور مبكر من النمو وتجعدها.

شكر

يشكر القائمون بالبحث الدكتور صالح محسن بدر رئيس قسم النخيل والتمور، مركز البحوث الزراعية والموارد المائية والسيد مدير عام الهيئة العامة للبستنة والغابات للمساعدة في توفير مستلزمات البحث. والشكر للسيد محمد سعيد ميسرة لقيامه بمهمة التحاليل المخبرية.

بد من الاهتمام بخدمات النخلة التي ترفع من جودة التمور ورفع قيمتها التجارية والغذائية. من بين هذه العمليات عملية خف الثمار التي يتبعها زراع النخيل في الولايات المتحدة بصورة تقليدية.

أثبتت نتائج هذه التجربة أهمية خف الثمار في رفع جودة ثمار الخستاوي بزيادة حجم الثمار ووزنها وتحسين مظهرها بتماثل أحجامها مما يزيد من قيمتها التجارية بين الأصناف التجارية التي تسوق بطريقة الكبس. ووضح من الطريقة التي أجريت بها هذه التجربة امكانية القيام بعملية الخف في نفس الوقت الذي تؤدى فيه عملية التلقيح لتقليل التكلفة وتوحيد جهد صعود النخلة. وأثبتت التجربة أن اجراء عملية خف الثمار بقص أطراف الشماريخ وخف 30٪ من الأزهار هي أفضل طريقة لخف الثمار من بين المعاملات التي أجرى تقييمها تحت ظروف التجربة (جدول رقم 2) ، حيث أمكن اجراء عمليتي التلقيح وخف الثمار ببذل جهد صعود واحد لقمة النخلة. ويمكن اتباع هذه الطريقة لخف الثمار دون تحمل عبء اضافي يذكر في الحالات التي يتم فيها تلقيح النخيل بالطرق التقليدية بوضع شماريخ الطلع على أغاريض النخيل الأنثوية. وبتطوير طرق التلقيح لاستخلاص غبار الطلع ودفعه يدوياً أو آلياً لتعفير طلع اناث النخل لا بد من مقابلة التكلفة الناجمة عن اجراء عملية خف الثمار بقص أطراف الشماريخ عند اجراء عملية التلقيح. كما أن تأجيل عملية الخف واجرائها مع عملية التركيس (التدلية) تساعد في توفير جهد صعود النخلة وتحديد نسبة خف الثمار غير ان النخلة تفقد نسبة أكبر من مخزونها الغذائي مقارنة مع النسبة المفقودة حين تقص اطراف الشماريخ عند اجراء عملية التلقيح.

ولا بد من تفادي المعاملات التي تسبب جفاف الثمار فقد أوضحت التجارب في وادي ريغ بالجزائر أن ازالة الشماريخ الوسطية من عذوق الصنف دقلة نور قد تسبب في جفاف الثمار وبدني نوعيتها (11). وقد تسببت

في يوم 26 من تشرين الأول (اكتوبر) عام 1983 حصدت الثمار وأخذت الملاحظات وبيانات وزن الثمار من كل عذق. ثم أخذت عينة من 50 ثمرة بطريقة عشوائية وجمعت بيانات عن متوسط وزن الثمار، وحللت الثمار لتحديد نسب السكر والرطوبة ونسبة المواد الصلبة الذائبة والرقم الهايدروجيني. حللت البيانات أحصائياً بالتصميم العشوائي الكامل.

النتائج

يبين الجدول رقم (1) تأثير عمليات خف الثمار على انتاج نخيل الخستاوي والصفات الثمرية للتمور الناتجة عن عملية الخف في التجربة التي أجريت عام 1982 في الزعفرانية. وأوضحت النتائج أثر عملية الخف على زيادة حجم الثمار وتماثلها وزيادة وزنها مع عدم ظهور زيادات مماثلة في وزن البذور. غير أن انتاجية النخيل في هذا البستان كانت متدنية بصورة عامة. وأوضحت التجربة فوارق كبيرة بين انتاجية النخلة والأخرى. وكانت الثمار طبيعية خالية من الثمار الجافة المتجعدة في جميع المعاملات.

يشير الجدول رقم (2) الى تأثير عمليات خف الثمار على انتاج الخستاوي والصفات الثمرية للتجربة التي أجريت عام 1983 في اللطيفية وأكدت نتائج هذه التجربة ملاحظات العام السابق من تأثير خف الثمار على زيادة حجم ووزن الثمرة ورفع نسبة النوعية الجيدة من الثمار (صورة رقم 1). غير أن الزيادة في حجم الثمار مصحوبة ببعض النقص في الانتاج الكلي للنخلة. وفي تجربة عام 1983 لوحظ جفاف بعض الثمار وتجعدها في المعاملات التي أزيلت فيها الشماريخ الوسطية عند اجراء عملية التلقيح (صورة رقم 2).

المناقشة

جودة الثمار من العوامل الهامة في رفع القيمة التجارية والغذائية للتمور. لذا فلا

(2) خف الثمار بنسبة 25٪بازالة الشماريخ الوسطية في 5 حزيران (يونيو) مع اجراء عملية التركيس.

(3) خف 15٪من الازهار عند التلقيح ثم خف 25٪من الثمار في حزيران (يونيو) عند اجراء عملية التركيس

(4) ازالة عذوق كاملة في 5 حزيران (يونيو) لمعدل عذق لكل 10 سعفات.

(5) نخيل محايدة للمقارنة

حصـدت الثمار بعد بلوغ آخر مراحل النضج في 16 تشرين أول (اكتوبر) 1982 وتم وزن انتاج كل نخلة. ثم أخذت عينات مكونة من 30 ثمرة بطريقة عشوائية لأجراء دراسات حجم الثمرة ووزنها ووزن البذور كما أخذت عينات عشوائية لتحليل نسبة الرطوبة والسكريات الكلية باستعمال طريقة برلين لتقدير السكريات (3).

ولوجود فارق كبير في انتاجية النخيل التي استعملت في تجربة عام 1982 في محطة الزعفرانية لذا فقد أعيدت التجربة في مزرعة اللطيفية على 5 نخلات (مكررات) في نفس العمر وتحت رعاية مماثلة من خدمات الري والتسميد ووقاية الآفات حيث طبقت جميع المعاملات الآتية على كل نخلة بمعدل عذقين من كل نخلة لكل معاملة في 9 أيار (مايو) من موسم 1983 كما يلي:

(1) مقارنة.

(2) خف الأزهار بنسبة 30٪بقص أطراف الشماريخ عند اجراء عملية التلقيح.

(3) خف الأزهار بنسبة 30٪بازالة الشماريخ الوسطية عند اجراء عملية التلقيح.

(4) خف الأزهار بنسبة 20٪بقص أطراف الشماريخ ثم خف حوالي 20٪من الثمار بازالة الشماريخ الوسطية عند اجراء عملية التلقيح ليكون الخف الاجمالي حوالي 36٪

بالتعاون بين المشروع الاقليمي لبحوث النخيل والتمور والهيئة العامة للبستنة والغابات لتحسين الصفات الثمرية لصنف الخستاوي

أثبتت عملية خف الثمار جدواها في تحسين الصفات الثمرية للتمور بزيادة وزن وحجم الثمار ورفع جودتها وتبكير نضجها والتقليل من ظاهرة تبادل الحمل (5، 4، 6، 7، 2، 8، 9، 10، 11، 12، 13، 14، 15) تجري عملية الخف بازالة العذوق الصغيرة والعذوق التي لم تعقد ثمارها بصورة جيدة وهي غالباً ما تظهر مبكرة أو متأخرة وهذه طريقة متبعة في العالم القديم. أما في الولايات المتحدة فان الخف يتم بقرط اطراف الشماريخ عند اجراء عملية التلقيح ثم تزال بعض الشماريخ الوسطية عند اجراء عملية التركيس (التدلية). وتتوقف مقادير الخف على طول وعدد الشماريخ والعوامل البيئية المحيطة.

المواد والطرق المستعملة

أجريت التجربة الأولى في عام 1982 على نخيل خستاوي في مزرعة الزعفرانية. كان عمر النخيل عند اجراء التجربة حوالي 20 عاماً وعلى كل نخلة بحدود 80-100 سعفة. زرعت النخيل على أبعاد 8×8 متر تتوسط صفوفها أشجار الحمضيات. تروى النخيل بانتظام وتستفيد من الأسمدة التي تسمد بها الحمضيات سنوياً. وتكافح الآفات وأهمها الحميرة والدوباس بعمليتي رش بمادة الاكتلك بتركيز 50٪ بمعدل 5 مليلترات لكل جالون ماء في أوائل أيار (مايو) عند عقد الثمار ورشه ثانية بعد 3 أسابيع من الرشة الأولى.

أجريت العمليات التالية على 15 نخلة بمعدل 3 نخلات (مكررات) لكل معاملة:

(1) قص أطراف الشماريخ لخف الأزهار بنسبة 30٪ في 16 أيار (مايو).

of pollination was reduced by 36% by cutting back tips of strands to reduce the fruit load by 20% plus further reduction of 20% of remaining fruits by removing entire central strands. Fruits resulting from non-thinned bunches and palms were significantly smaller compared to fruits collected from thinned bunches. There was no positive correlation between fruit and seed weights among the treatments indicating that the increase in weight was due to increase in the weight of pulp. Fruits collected from weak bunches with lower fruit load were drier, lighter in weight with a greater tendency of epicarp to separate from the flesh.

It was concluded that fruit thinning by cutting back tips of strands to reduce the initial fruit load by about 30% at the time of pollination and removing weak bunches with low fruit load at the time of bunch bending six weeks later are useful bunch management practices to produce high quality Khastawi dates in Central Iraq.

مقدمة

الخستاوي من أصناف التمور الشهيرة في وسط العراق حيث يأتي في المرتبة الثانية بعد الزهدي في عددية النخيل. تسوق تمور الخستاوي بطريقة الكبس ويصدر منه العراق لأوروبا والولايات المتحدة وبعض الدول العربية. ثمار الخستاوي صغيرة الى متوسطة الحجم وهي لينة قليلة الألياف لذيذة الطعم بيضوية مستطيلة الشكل، حمراء مسمرة اللون، قشورها متوسطة السمك تميل للانفصال من اللحم، قمعها كبير وحافته غائرة وتكون نواتها 11٪من نسبة التمرة (1، 16).

تستهلك 95٪من تمور العالم مباشرة في مراحل النضج المختلفة معبأة في عبوات مختلفة. ويتطلب مستهلكو التمر (في أوروبا والولايات المتحدة خاصة) مواصفات للتمور لا بد من مقابلتها لضمان المردود المنشود. ولأهمية حجم وشكل ومظهر الثمار في قيمة التمور التي تسوق معبأة فقد أجريت هذه التجربة في وسط العراق

أن تأثير عمليات الخف كان بزيادة لحم (لب) الثمرة. وكانت ثمار العذوق الضعيفة الخفيفة الحمل خفيفة الوزن وجافة تميل قشورها للانفصال كما أن طعمها لم يكن جيداً ومظهرها لم يكن مقبولاً.

ويستنتج من هذه الدراسات أن خف ثمار الخستاوي بقص أطراف الشماريخ عند اجراء عملية التلقيح بخف 30٪من الثمار ثم ازالة العذوق الضعيفة عند التذليل (التركيس) من عمليات معاملة العذوق المفيدة لتوفير تمور ذات صفات ثمرية جيدة لأغراض الكبس في وسط العراق.

SOME STUDIES ON FRUIT THINNING OF KHASTAWI DATES IN CENTRAL IRAQ

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ABSTRACT

Experiments were conducted at the stations of Zafarania in 1982 season and Latifiya in 1983 season to compare 3 methods of thinning Khastawi dates and study its effect on yield and fruit quality. The results showed that fruit thinning improves the quality of Khastawi fruits by increasing fruit size and weight, and production of uniform fruits with higher % of T.S.S. and sugars but 20 % reduction in yield. The best method of thinning was found to be cutting back the tips of strands at the time of pollination to reduce female flowers about 30%. This gave fruits with the best characteristics of size, shape and quality. Removal of entire central strands at the time of pollination, to reduce potential fruit load by 30% resulted in increase of fruit size and weight, but with 1% shrivelled fruits in high yielding palms and higher percentage in low yielding palms. Fruit shrivelling was also observed in treatment in which the potential fruit load at the time

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دراسات على خف ثمار الخستاوي بوسط العراق

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الخلاصة

أجريت التجربة في محطة الزعفرانية في موسم 1982، وفي اللطيفية في موسم 1983، لمقارنة ثلاث طرق لخف ثمار الخستاوي ودراسة أثر الخف على الانتاج والصفات الثمرية لهذا الصنف التجاري الهام في وسط العراق. وأوضحت النتائج أن عملية خف الثمار تزيد في تحسين الصفات الثمرية لصنف الخستاوي بزيادة حجم الثمار ووزنها وتماثل احجامها ومظهرها وزيادة النسبة المئوية من السكريات والمواد الصلبة إلا أنها تؤدى الى خفض 20٪من انتاجية النخلة. ووجد أن أفضل طريقة لاجراء عملية الخف هي قص أطراف الشماريخ عند اجراء عملية التلقيح لتخفيض الثمار بنسبة 30٪ حيث تميزت الثمار الناتجة بأجود الصفات الثمرية من الحجم والشكل والجودة. ووجد أن أحجام وأوزان الثمار تزيد أيضاً بخف الثمار بنسبة 30٪ بإزالة الشماريخ الوسطية عند اجراء عملية التلقيح، إلا أن 1٪ من الثمار ونسبة أعلى من ثمار النخيل الخفيفة الحمل تكون ذابلة. كما لوحظ نفس الحالة عند دمج معاملتي قص أطراف الشماريخ مع ازالة الشماريخ الوسطية لخف الثمار بنسبة 36٪عند اجراء عملية التلقيح. وكانت ثمار النخيل غير المعاملة صغيرة بالمقارنة لثمار النخيل التي أجريت عليها عمليات خف الثمار بنسبة مؤكدة احصائياً. ولم تلاحظ علاقة اضطرادية بين وزن البذور والثمار من أثر معاملات الخف مما يؤكد

المحتويات

رقم الايداع في المكتبة الوطنية ببغداد
٤٤٠ لسنة ١٩٨١

4
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