5
1984

THE DATE PALM JOURNAL

PUBLISHED HALF-YEARLY BY THE FAO REGIONAL PROJECT
FOR PALM & DATES RESEARCH CENTRE IN THE NEAR EAST & NORTH AFRICA

P.O.Box 10085 Karradah Al-Sharkiyah, Baghdad, IRAQ. Telex 212699 IK
Telephone: 7762278; 7765934

June 1984 – ISSN 0252 – 3353 Vol. 3 (1): 268-358

Date Palm J 3 (1)
Published 1984

EDITORIAL

This issue of the Date Palm Journal contains 8 research papers, a short communication and a section on documentation. Propagation by offshoots is slow cumbersome and expensive. Tissue culture of date palm has therefore attracted considerable attention as a convenient means of mass multiplication of desirable varieties. Zaid presents a review of *in vitro* browning of tissues and media with special emphasis to date palm cultivars.

El-Shurafa reports on the amount of minerals annually lost by way of fruit harvest and pruning of date palm trees to plan a precise fertilization programme for date palm orchards. Hussain *et al.* present the effect of spraying the infloresences on date palm with pollen grains suspended in Boron GA_3 and glycerin solutions on fruit set and yield. It was found out that the influence of pollen suspended with Boron and GA_3 on fruit set and yield was not significantly different from other media like glycerine-sucrose and water.

Bukhaev *et al.* present chemical analysis of frond bases of date palm leaves to study the reaction of chlorine to understand the bleaching process.

Mutlak and Mann has studied effect of microwave heating to control deterioration of dates in storage which results in undesireable changes in appearance, taste and food value of dates. El Mubarak Ali and Osman have reported on the industrial utilization of Sudanese dates at various stages of maturity to prepare jam.

Carpophilus hemipterus L. is an important pest of stored dates in Iraq and various methods are employed for control. However, some undesirable effects are associated with the use of chemical insecticides from pests developing resistance to insecticides and residues which may result in health hazard to consumers. Al Azzawi *et al* present the effect of high temperatures on dates with different developmental stages of the pest. Al

Hakkak and co-workers present part III of their series of papers to study the use of gamma radiation on *Ephestia cautella* (Walker).

Howard *et al.* have reported that Zahdi, Deglet Noor and Thoory date cultivars are susceptible to lethal yellowing grown in southern Florida. Full text of the study will be published in the next issue of the JOURNAL.

Mohan (of the Regional Project) presents abstracts of research papers on date palms and a glance at the papers presented at the first symposium on the date palm held in Saudi Arabia.

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 balck 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/hetare 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.

Date Palm J 3 (1): 269 – 275
Published 1984

IN VITRO BROWNING OF TISSUES AND MEDIA WITH SPECIAL EMPHASIS TO DATE PALM CULTURES A REVIEW

A. ZAID

Statien Centrale d'Agronomie, Saharienne B.P. 533
Marrakech, Morocco

INTRODUCTION

During the course of growth and development *in vitro*, plant tissues not only depleted the nutrients that are furnished in the medium, but also release substances that can accumulate in the cultures. These substances, such as phenols, may have profound physiological effects on the cultured tissues. Browning of the tissue and the adjacent medium is assumed to be due to the oxidation of polyphenols and formation of guinones which are highly reactive and toxic to the tissues (15).

Phenolic compounds always contain at least one hydroxy group on the benzene ring. Several enzymes which are widely distributed in plants oxidize phenols to guinones e.g. monophenol oxidase (tryosinase) and polyphenol oxidase (catecholoxidase). During the redox reaction, the hydroxyl group is oxidized resulting in the formation of guinone and water (14). The same authors (14), suggest that other inhibitory actions may result from the bonding of phenols and proteins and their subsequent oxidation to guinones, such as the loss of various enzyme activities. The phenols and the phenolic oxidases of intact tissues are apparently situated in separate pools or compartments within the cell (16). Following tissue wounding or senescence, these pools are integrated and the oxidation process is initiated.

Pelletier and Ilamin (18) working with tobacco demonstrated the existence of two major periods of intensive browning; one within the first 10

days and the other after 25 days of culture. Drastic browning in the early period of the culture may result from some wound or physiological changes stemming from the excision from the mother plant. While the gradual browning is considered to be an expression of the process of senescence of the explant itself.

EFFECT OF HORMONES, CULTURAL CONDITIONS AND ACTIVATED CHARCOAL

Presence of certain hormonal substances in the nutrient media might bring about browning in cultured tissues, either directly or indirectly. Rabechault *et al* (21) showed that high auxins concentration, namely 2,4 – D and IAA, delayed the initiation of polyphenol synthesis and reduced the subsequent rate of observable browning. The same authors also reported a decreased browning when 1% sucrose was included in the culture medium, in addition to 2,4 – D. Davis (7), however, suggests that at least in the early stages of tissue growth, inhibition may be due to the effect of 2,4 – D and not to the release of polyphenols. Cytokinins are known to stimulate the synthesis of phenolic compounds (5). Asahira and Nitsch (3) and (21) reported an enhanced browning in tissue cultured in kinetin-enriched medium, but lacking ammonium ions.

Physical characters, as well as cultural conditions may also play a role in the process of browning. Raising the pH value in the medium from 2.5 to 5.6 caused an increased browning (2). Similarly, high temperature inside the transfer chamber enhanced the phenolic oxidation reaction, thus increased browning (16). The same authors also reported that cultures grown in the dark exhibited less browning than those incubated under light conditions.

Position of the explant in culture vessel and method of implantation may be a factor in browning. Dupaigne (8) observed that excised stem segments of a clone of *Dioscorea batatas* produced a marked browning in the medium when planted basipetally, but not when planted acropetally, however.

Activated charcoal (hereafter abbreviated AC) has been used as light adsorber in agar nutrient substrates to prevent light induced growth inhibition of tissues (13,20). Proskauer & Bermann (20) attributed the AC

beneficial effects to the darkening of the medium simulating the natural soil characteristics. However, this growth improvement effect could not be reproduced by wrapping the culture vessels with aluminum foil to exclude light from the nutrient media or by placing the cultures in constant darkeness (28). AC mode of action is through adsorption of toxic metabolites released by the plant tissues (10). It also adsorbs gases, and perhaps growth of injured explants may be due to ethylene absorption (9). Fridborg *et al.* (11) using mass spectrometry showed that the media without AC contained high amounts of phenylacetic acids: p-OH- benzoic acid; 2,6-oH-benzoic acid; pelargonc acid; and caprylic acid depending on the tissue cultured on it. Whereas the media with AC containing the same explants did not. Further, it was also shown that p-HO-benzoic acid had inhibitory effects on the somatic embryogenesis process in *Daucus* cultures.

Addition of AC at optimal concentrations of 1% (Grade G-60) or 2% (Merck, A.G., Darmstadt) in the culture medium has been reported (4) to apparently prevent accumulation of inhibitory substances in the culture medium. Constantin *et al* (6) suggested that the phytohormones required for callus growth and shoot development of tobacco are adsorbed by charcoal addition. Thus the removal of hormones from the medium by AC causes callus growth to be inhibited severely and shoot development to be prohibited. Similarly, Fridborg and Erikson (10), postulated that the addition of charcoal to a culture medium drastically alters the properties of the medium. Hence, growth regulator substances are tested at high levels with charcoal included in the nutrient media to obtain beneficial effects on tissues (29).

BROWNING IN DATE PALM AND TECHNIQUES USED

Date palm, *Phoenix dactylifera* L., tissue cultures like those of many other plants, have been commonly observed to release discolouring substances into the medium, which inhibit their own growth.

For date, injury through cutting of tissue is accompanied by secretion of the substance into the medium. The intact organ, as exemplified by embryos or whole leaves or tips do not brown and thus grow well in culture (22). However, in palm tissues, browning seems to be an omnipresent

phenomenon since changing of external factors, such as lowering the pH of the medium, or omitting glycine and kinetin, has failed to reduce its occurrence (22).

To minimize browning, Murashige (17), has suggested the pre-soaking of explants in ascorbic and citric acid solutions and adding them to the culture medium for curtailing the oxidation of the phenolics. Zaid and Tisserat (30) soaked their date palm explants in an antioxidant solution (150mg/1 citric acid and 100 mg/1 ascorbic acid) prior to the surface sterilization treatments. Poulain *et al* (19), rinsed their disinfested date palm explants with a sterile distilled water supplemented with the following anti-oxidants and adsorbants in gm/liter: cafeine, 2; sodium dichyldithiocarbonate, 1; and polyvinglpyrrolodone (PVP), 1. Addition of a combination of adsorbants including citrate, adenine, glutamine, and PVP retarded browning in date palm explants (24). Jones (12) added phloroglycinol to his medium and obtained increased shoot proliferation and rooting. Addition of other adsorbants to nutrient media such as dihydroxynaphtalene, dimethylsulfoxide, were ineffective against browning in date palm explants (22, 27). Apavatjrut & Blake (1) suggested that browning could be eliminated by a nutritionally balanced medium. Excision of browning explants parts during culture was also advocated to prevent this problem (26).

The use of charcoal is preferred over cysteine and other adsorbants because the latersare of ten toxic to the plant tissues at higher concentrations (25). According to (22), the addition of AC proved effective for a limited period only. After one or two transfers the already familiar medium browning occured and tissues ceased growth. Zaid and Tisserat (30) found that shoot tips and lateral buds cultured on nutrient media without charcoal exhibited severe browning and growth inhibition. Addition of 3 g/1 charcoal has caused substantial root and shoot growth of date palm embryos (21, 23). Inclusion of charcoal, as mentioned earlier, reduced the availability of hormonal substances. It is therefore necessary to apply an abnormally high concentrations of auxins (27, 30).

Recently, Zaid and Tisserat (30) found that this browning could be minimized without addition of charcoal to the nutrient medium by employing

small explants, i.e.apical meristem, and reculturing them to fresh medium after a short period of incubation. Apparently, the most lethal of the browning components are produced during the initial culture of the explant.

CONCLUSION

Taken together, the results obtained by date palm tissue culturists and their approaches to solve the browning phenomenon suggest the following:

1) Pre-soaking of explants in an antioxidant solution of 150mg/1 citric acid and 100mg/1 ascorbic acid.

2) Employing small explants, and reculturing them to fresh medium after a short period of incubation.

3) Hence, charcoal reduced the availability of hormones it is necessary to supply a high concentration of auxins. A series of future experiments has been designed to assist in resolving the browning phenomenon without using adsorbants.

LITERATURE CITED

1. APAVATJRUT, P. & J. BLAKE. (1977): Tissue culture of stem explants of coconut *Cocos nucifera* L.). Oléag., 32 (6): 267 – 271.
2. ARORA, S.K. (1969): Browning of phenols and its inhibition by aliphatic acids. Z. Naturforschg 24b: 1198 – 1199.
3. ASAHIRA, T. & J.P. NITSCH (1969): Effect of polarity and kinetin on the browning reaction of *(Dioscorea batatas)* and *D. japonila.* Planta 84: 292 – 294
4. BAJAJ, Y.P.S. (1978): Regeneration of haploid tobacco plants from isolated pollen grown in drop culture. Indian J.Exp. Biol. 16: 407 – 409.
5. BERGMANN, L. (1964): Der Einflub Von Kinetin auf die Ligninbildung und differenzierung in Gewebekulturen von *Nicotiana tabacum.* Planta 62: 221-254.
6. CONSTANTIN, M.J.; R.R. HENKE & M.A. MANSUR (1977): Effect of activated charcoal on callus growth and shoot organogenesis in tobacco. In Vitro 13: 293 – 296.
7. DAVIS, J.E. (1972): Effects of auxin in polyphenol accumulation and the development of phenylalanine Ammonia-Lyase activity in dark-grown suspension cultures of Paul's Scarlet Rose. Planta 104: 66 – 77.
8. DUPAIGNE, G. (1967): Recherches sur la physiologie de la tuberisation. Diplôme d'études approfondies de physiologie végétale appliquée. Paris, Sorbonne.
9. ERNST, R. (1974): The use of activated charcoal in a symbiotic seedling culture of *Paphiopedilum.* Am. Orchid. Soc. Bull. 43: 35 – 38.
10. FRIDBORG, G. & T. ERIKSSON (1975): Effects of activated charcoal on growth and morphogenesis in cell cultures. Physiol. Plant. 34: 306 – 308.
11. FRIDBORG, G.; M. PEDERSEN; L. LANDSTRON & T. ERIKSSON (1978): The effect of activated charcoal on tissue cultures: Adsorption of metabolites inhibiting morphogenesis. Physiol. Plant 43: 104 – 106.
12. JONES, L.H. (1974): Propagation of clonal oil palm by tissue culture. Oil Palm News 17: 1 – 9.
13. KLEIN, B. & M. BOPP (1971); Effect of activated charcoal in agar on the culture of lower plants. Nature 230: 474.
14. LOOMIS, W.D. & J. BATTAILE (1966): Plant phenolic compounds and the isolation of plant enzymes. Phytochem. 5: 423 – 438.
15. MAIER, V. & D.M. METZLIER (1965): Quantitative changes in date polyphenols and their relation to browning. J.Food Sci., 30: 80 – 84.
16. MONACO, L.C.; C.R. LOPES & M.L. CARELLI (1977): Isomeros de acido chlorogenico em especies de coffea. Ciencia Cultura, Recife, 26: 240.
17. MURASHIGE, T. (1974): Plant propagation through tissue cultures. Ann. Rev. Plant Physiol., 25: 135 – 166.
18. PELLETIER, G. & M. ILAMI (1972): Les facteurs de l'androgenese *in vitro* chez *Nicotiana tabacum.* Z.Pflanzenphysiol., 68: 97 – 114.

19. POULAIN, C.; A.RHISS & G. BEAUCHESNE (1979): Multiplication végétative en culture *in vitro* du palmier dattier *(P. dactylifera)*. C.R. acad. Agric., II: 1151 – 1154.
20. PROSKAUER, J. & R. BERMAN (1970): Agar culture medium modified to approximate soil conditions. Nature, 227: 1161.
21. RABECHAULT, H.; J.P. MARTIN & S. GAS (1976): XII. Effets de substances de croissance à des doses superoptimales. Relation avec le brunissement des tissus. Oléag., 31 (4): 159 – 163.
22. REUVENI, O. & H.L. KIPNIS (1974): Studies of the *in vitro* culture of date palm *(Phoenix dactylifera* L.) tissues and organs. Pamphlet No. 145: 40 pp.
23. REYNOLDS, J.F. & T. MURASHIGE (1979): Asexual embryogenesis in callus cultures of palms. In Vitro, 15: 383 – 387.
24. RHISS, A; C. POULAIN & G. BEAUCHESNE (1979): La culture *in vitro* appliquée à la multiplication végétative du palmier dattier *(Phoenix dactylifera* L.) Fruits, 34: 551 – 554.
25. SHARMA, D.R.; R. KUMARI & J.B. CHOWDHMRY (1980): *In vitro* culture of female date palm *(P. dactylifera* L.) tissues. Euphytica, 29: 169 – 174.
26. SMITH, W.K. & J.A. THOMAS (1973): The isolation and *in vitro* cultivation of cells of *Elaeis guineensis* J. Oléag., 3: 123 – 127.
27. TISSERAT, B.H. (1979): Propagation of date palm *(P.dactylifera* L.) *in vitro*. Exp. Bot. 30: 1275 – 1283.
28. WANG, P.J. & L.C. HUANG (1976): Beneficial effects of activated charcoal on plant tissue and organ cultures. *In Vitro,* 12: 260 – 262.
29. ZAID, A. (1981): Rapid propagation of the date palm through tissue culture. Master of Sciences thesis at the U.S. Date & Citrus Station, Indio, California. (U.S.A.): 178 pp.
30. ZAID, A & B.H. TISSERAT (1983): *In vitro* shoot tip differentiation in *Phoenix dactylifera* L. Date Palm J., 2 (2): 163 – 182.

Date Palm J 3 (1): 277 – 290
Published 1984

STUDIES ON THE AMOUNT OF MINERALS ANNUALLY LOST BY WAY OF FRUIT HARVEST AND LEAF PRUNINGS OF DATE PALM TREE*

M.Y. El-SHURAFA

Department of Arid Land Agriculture, Faculty of Meteorology and Environmental Studies, King Abdulaziz University, Jeddah, Saudi Arabia

ABSTRACT

Sodium and eight nutrient elements (N, P, K, Ca, Fe, Mn, Zn and Cu) were determined in the different parts of the date palm tree (flesh, seed, fruit strands, bunch, stalk, pinnae and rachis) in an attempt to obtain an estimate of the amount of minerals lost by way of fruit harvest and leaf prunings. The lowest and highest values of mineral content observed (based on dry-matter) were as follows: N 0.185% for rachis and 1.160% for pinnae; P. 0.024% for rachis and 0.125% for seed; K 0.071% for pinnae and 1.1089% for stalk; Ca 0.125% for seed and 0.533% for pinnae; Na 0.0034% for seed and 0.142% for rachis; Fe 18.9 ppm for seed and 255 ppm for pinnae; Mn 1.6 ppm for stalk and 44ppm for pinnae; Zn 3.6 ppm for flesh and 32.6 ppm for pinnae Ash contents ranged from 2.47% for flesh to 9.34% for stalk. It was estimated that each palm lost about 82.4 kg of dry matter annually by way of fruit harvest and leaf pruning. This was calculated to contain 472.4 g N, 47.7 g P, 422.6 g K, 218.9 g Ca, 36.4 g Na, 5.8 g Fe, 1.2 g Mn and 1.3 g Zn Whole Fruits (flesh and seed) drew the greatest amount of N (272 g), P (30.8 g) and K 310.8 g from the soil, whereas leaf prunings (pinnae and rachises) drew the greatest amount of Na (29.7 g), Ca (138.7 g), Fe (4.0g), Mn (0.85 g) and Zn (0.32 g).

---

* This work was carried out in Libya Department of Horticulture, Faculty of Agriculture, University of Al-Fateh,Tripoli.

دراسات على كميات العناصر الغذائية التي تفقد سنوياً من نخلة التمر عن طريق جمع المحصول وتقليم الاوراق

محمد يوسف الشرفا
قسم زراعة المناطق الجافة ـ كلية الارصاد والدراسات البيئية
جامعة الملك عبدالعزيز ـ جدة

الخلاصة

تم تقدير الصوديوم وثمانية عناصر غذائية وهي (نتروجين، فوسفور، بوتاسيوم، كالسيوم، منجنيز، حديد، زنك، نحاس) في كل من لحم الثمار والبذور والشماريخ وعنق العذق وكذلك في الوريقات والعرق الوسطى للأوراق التي في عمر التقليم بغرض تقدير ومقارنة التركيب المعدني للاجزاء المختلفة لنخلة التمر وكذلك حساب كميات العناصر التي تفقد سنوياً نتيجة لجمع المحصول وتقليم الاوراق، هذا وقد جمعت العينات من أشجار نخيل مثمرة من صنف « طابوني » تقع في عدة مزارع في منطقة الخمس في شمال ليبيا .

تبين من التحليل الكيماوي أن هناك تفاوتاً كبيراً في المحتوى المعدني للاجزاء المختلفة وفيما يلي أقل وأعلى تركيز للعناصر المقدرة:

نتروجين	0.185٪	في العرق الوسطى	1.160٪ في الوريقات
فوسفور	0.024٪	في العرق الوسطى	0.125٪ في البذور
بوتاسيوم	0.071٪	في الوريقات	1.108٪ في عنق العذق
كالسيوم	0.125٪	في البذور	0.533% في الوريقات
صوديوم	0.0034٪	في البذور	0.142٪ في العرق الوسطى
منجنيز	1.6	جزء في المليون في عنق العذق	44 جزء في المليون في الوريقات
حديد	18.9	جزء في المليون في البذرة	255 جزء في المليون في الوريقات

زنك	3.6٪	جزء في المليون في لحم الثمار	32.6	جزء في المليون في الوريقات	
الرماد	2.47٪	في الثمار	0.34%	في عنق العذق .	

وقد قدرت كمية المادة الجافة التي تفقدها النخلة الواحدة سنوياً نتيجة لجمع المحصول وتقليم الاوراق بحوالي 82.4 كغم وذلك بافتراض أن النخلة تنتج سنوياً 100 كغم ثمار خلال ورطب، 10 عذوق، c. ورقة وهذه الكمية من المادة الجافة تحتوي على 472.4 نتروجين، 47.7 غم فوسفور، 422.6 غم بوتاسيوم 218.9 غم كالسيوم، 36.4 غم صوديوم، 5.8 غم حديد، 1.2 غم منجنيز، 1.3 غم زنك .

تبين من النتائج أن الثمار وحدها (اللحم والبذور) أدت الى فقد معظم كميات النتروجين 272 غم، والفوسفور 30.8 غم، والبوتاسيوم 310.8 غم، بينما أدى تقليم الاوراق الى فقد معظم كميات الصوديوم 29.7 غم، والكالسيوم 138.7 غم، الحديد 4.01 غم، المنجنيز 0.4 غم، والزنك 0.32 غم .

هذه الكميات من العناصر التي تفقد سنوياً يجب تعويضها عن طريق اضافة الاسمدة حتى يمكن المحافظة على انتاجية الأشجار، بعد أن يؤخذ في الاعتبار كميات العناصر التي تستنفذ أو تفقد نتيجة للعوامل الأخرى مثل الصرف وعمليات تثبيت العناصر في التربة ووجود زراعات بينية وغيرها .

INTRODUCTION

A significant part of the nutrient elements taken up by date palm tree are annually lost by way of fruit harvest and leaf prunings. An assay of the mineral content of the different parts of fruit bunch including seed, flesh, fruit strands and bunch stalk and also pinnae and rachis of leaf prunings can provide a quantitative appraisal of the amount of minerals annually removed by these parts away from the plantation. These data give a clear picture on the amount of minerals annually absorbed by the whole palm under our experimental and environmental conditions.

Many studies have been reported on the mineral content of flesh (4, 5, 8, 9, 11, 12, 16, 21) Seed (6, 8, 11, 12, 13) fruit stalk (7) pinnae (4, 7, 8, 10, 12, 14, 15, 18, 19, 20) and rachis (7, 20), however, few attempts have been made to estimate the total quantities of minerals annually drawn or removed by fruit bunches, leaf prunings or by the whole palm. Embleton and Cook (7) calculated that a moderate annual prunings of leaf and fruit bunches of one date palm consists of approximately 44kg. of dry matter. This contains 213g N, 16g. P. and 611g K. Bliss and Hass (1) estimated that the flesh of the fruit of a palm yielding 9000 fruit would contain about 239 gN, 41 g. P and 587 g K. In coconut palm, according to the study of Pillal and Davis (17) each palm annually removes 549 g N, 115 g. P, 635 g. K, 497 g. Ca and 196 g. Mg.

The object of the present study was to determine and compare the mineral content of flesh, seed, strands, stalk, pinnae and rachis in an attempt to establish an estimate of the amount of minerals annually removed by the individual parts and whole palm. This can help to provide a precise scientific basis for planning fertilizer program for date palm orchards.

MATERIAL AND METHODS

Date palm *(Phoenix dactylifera* L.) cultivar, Tabuuni was used in this study. It is one of the commonly grown cultivars in the coastal region of Libya. This region is characterized by high relative humidity (60 – 75%) and insufficient effective heat units (1100°C – 1400°C)*. The fruit in most cases is, therefore, harvested at khalaal and rutab stages (3).

Sampling, measurements and analysis: Samples were collected in the last week of October , 1981 from three different orchards in Khomis district (130Km. east of Tripoli). Two mature palms – more than 10 years old and in full production-were chosen from each orchard and used for the determination of fresh and dry weights and mineral contents of flesh, seed, strand, stalk, pinnae and rachis. Nearly two kg. of fruit at khalal and rutab stages were harvested separately from individual palm. From this a sample of 50 fruits was drawn at randon and used for measurements and

★ Maximum temp + Minimum temp.

analysis of flesh and seed. Strands and stalk samples were taken from two separate bunches per selected tree. To make a representative sample of stalk, small segments of stalk were taken from various position and then composited. Two pruning age leaves, located below the fruiting zone, were detached from each palm and 18 pinnae were excised from each leaf. Six near the tip of the rachis, six from the middle blade and six near the base. The 18 pinnae were composited. Representative samples of rachis were obtained by sectioning out material near the base, middle and tip. The fresh weight of flesh and seed per fruit, strands and stalk per bunch and pinnae and rachis per leaf were also recorded. All the samples were dried in draft oven at 70°C to constant weight. These were then ground for mineral determination. Two grams of the ground material were digested with Hcl (dry ashing). Analysis of K, Ca, Na was done by flame photometer (Corning 400) Fe, Zn, Mn, Cu by atomic absorption, (Perkin-Elmer 500), P by spectrophotometry and N by Micro-Kjeldahle method (2). A partial analysis of soil characteristics was carried out on duplicate samples of each orchard according to Chapman and Pratt (2). The values were as follows: Sand 54.2%, Silt 23.1%, Clay 22.6%, pH 7.7, Ece. 91mmhos/c. Ca^{++3} meg/L, Hco_3 1.9 meg/L and cl^{-}2.46 meg/L. No systematic fertilization programme was ever followed for these orchards except that was added for the intercropped plants.

Computations: Mineral assay were based on dry weight and results were expressed as percent for N, P , K, Ca, Na and ash and as ppm for Fe, Mn, Zn, and Cu. Concentration of minerals of whole fruit, whole bunch (stalk and strands) and whole leaf were derived by calculation from those for seed and flesh, strand and stalk, and pinnae and rachis respectively.

Similarly, to establish uniform perspective for the different variables, the computations of the amount of minerals annually removed per palm or per part were based upon the assumption that each palm tree, on the average; produce 100 kg of fruits (at Khalal or rutab stage) 10 bunches and 20 leaves yearly. Differences in mineral content among the different parts were subjected to statistical analysis using analysis of variable.

RESULTS AND DISCUSSIONS

Dry weight: The quantitative data on fresh and dry weights of flesh and seed per fruit, stalk and strands per bunch and pinnae and rachis per leaf are given in Table 1. To draw a more practical picture these data were used to compute the dry matter produced by each individual part per palm per year. Each palm would supply approximately 82.4 kg. of dry matter annually ot which 47.3% was accumulated in the flesh of fruit. Of the remainder 12.1% goes to seed, 2.6% to fruit strands; 4.6% to bunch stalk; 16.5% to pinnae, and 16.8% to rachis (Table 1).

Mineral composition: Data on chemical analysis of the different parts of date palm tree are presented in Table 2. With regards to the mineral contents no great variations were found between flesh or seeds at Khalal and rutab stages except for K where it was significantly higher at Khalal stage. Studies on fruit flesh of the world's most popular date cultivars showed a wide variation in their mineral content. Ranges reported were as follows: N.0.4 – 1.0%; PO.041 – 0.31%; K 0.57 – 1.04%; Ca 0.054 – 0.219%, Na 0.005 – 0.39%; Fe 5 – 103 ppm; Mn 2-75 ppm; Zn 7-76 ppm, and Cu 4-29 ppm (4, 5, 8, 9, 11, 12, 16, 21). Evedently, these variations are attributable to differences between cultivars, stages of maturity and agroclimatic factors. However, the concentration of all minerals in fruit flesh, determined in the present study were generally within these ranges.

Comparing the different parts of date palm tree with respect to mineral contents, the data showed that, total N was the highest in pinnae (1.16%) and seed (1.001%) and lowest in the rachis (0.185%) and bunch stalk (0.260%).

This tends to suggest that rachis and stalk primarily comprise of the conducting system and do not store N. The phosphorus content was greater in seed (0.125%) than in any other part of date palm tree. It contained two or more times as much P as the flesh or strands and over 4 times as much as the rachis or stalk. The potassium content was highest in the bunch stalk i.e. 1.108% of the dry weight. The value in flesh at Khalal stage was slightly lower, whereas the pinnae showed the lowest value (.071%) (Table 2). Embleton and Cook (7) noted exceptionally high value

(4.33%) for K content of "Deglet Noor" fruit stalk. The calcium and Sodium contents in the felsh and seeds and ash in the flesh were significantly lower than those of strands, stalk, pinnae and rachis. The differences were much greater in the case of Na (Table 2). Pinnae contained higher amounts of Fe (255 ppm), Mn (44 ppm) and Zn (32.6 ppm) as compared to other parts. The differences were more pronounced in the case of iron. Amounts of Fe in pinnae were over 6 times of rachis and stalk and over 9 times that of seed and flesh (Table 2). Chemical analysis of pinnae of the more important cultivars showed a wide difference in the mineral content of pinnae (4, 7, 8, 10, 12, 14, 15, 18, 19, 20). The following ranges were reported: N 1.33 – 2.55%; P 0.085 – 0.32%; K.47 – 1.64%; Ca 0.27 – .79%. Na 0.007 – 0.159%; Fe 60 – 373 ppm, Mn 24 – 192 ppm; and Zn 6 – 16 ppm. These differences might be due to leaf age or the varity, agroclimatic conditions and cultivar behaviour. The observed values of N, P and K in the present data are relatively low as compared to the previously published reports. Possibly this difference is due to the age of leaves used (4 years old), since many studies on the seasonal changes of N, P and K showed that N and K content decreased greatly with age (4, 15, 18, 20). Situation about P; however is controversial it has been shown to decrease as the leaf become older (4, 15), or that leaf age had minor influence in P content (18, 20). Ruther (18) assumes this decline is due to the migration of these elements out of leaf to younger tissues or/and to accumulation of other material such as cellulose and Silica which possibly can have some diluting effect on N, P and K.

Estimated amounts of minerals annually removed by the different parts of date palm tree. Estimated amount of minerals annually removed or drawn from the soil by flesh, seeds, strands, stalks, pinnae and rachis are illustrated in Fig. 1., it is clear that in comparison with other parts the fruit-flesh removed the highest amount of N (172.0 g.), P (18.3 g.) and K (294. g.). Pinnae removed the greatest amount of Fe (3.5 g.) Mn (.59 g.), Zn (.32 g) and Ca (72.3 g.), whereas rachis removed the highest amount of Na (19.7 g.). A notable point is that the fruit-flesh, rachis and pinnae accumulated approximately the same amounts of ash (Fig. 1).

The total amount of minerals, per palm per year, lost by way of fruit

harvest and leaf pruning, are illustrated in Fig. 2. It was calculated that each palm annually removes 472. g. N; 422.6 g. K; 219 g. Ca; 48 G. P; 36.4 g. Na; 5.8 g. Fe; 1.2 g. Mn; 1.3 g. Zn and 3.389 kg ash from the soil. To remain productive these amounts should be made up by replenishing the tree with fertilizers.

It is envisaged that, these data will be valuable in planning a precise fertilization program for date palm orchards. In doing so, however, the amounts of nutrients absorbed by intercropped plants, lost in soil drainage or deficient to the date palm due to the formation of insoluble compounds in the soil must also be taken into account.

ACKNOWLEDGEMENT

The author is grateful to Dr. Habib-ul-Rahman Mian Abdul Aziz, Faculty of Meteorology & Environmental Studies, King Abdulaziz University, Jeddah for his valuable assistance in discussing the results and reading the manuscript.

LITERATURE CITED

1. Bliss, D.E. & A.R.C. Hass (1934): The relation of growth and chemical composition of Deglet Noor dates to water injury. Date Growers' Inst. Rep. 11: 6-9.
2. Chapman, D.H. & P.E. Pratt (1961): Methods of analysis for soil, plant and waters. Univ. of Calif. Div. of Agric. Sci.
3. El-Shurafa M.Y. (1982): Studies on the climatic conditions and geographic distribution of date palm producing reas in Libya. The First Symposium on Date Palm. King Faisal University Al-Hasa., Saudi Arabia.
4. El-Shurafa, M.Y. & S.E. Abou Nagi (1979): Changes of minerals in fruits and leaves of date palm during fruit development . Libyan J. Agric. 8: 107-113.
5. El-Shurafa, M.Y., H.S. Ahmed and S.E. Abou Nagi (1980): Mineral contents of fruits of six leading date cultivars of Southern Libya. Libyan J. Agric. 9:91-95.
6. El-Shurafa, M.Y., H.S. Ahmed & S.E. Abou Nagi (1982): Organic and inorganic constituents of date palm pit. Date Palm J. 1 (2): 275-284.
7. Embleton, T.W. & J.A. (1947): The fertilizer value of date leaf and fruit stalk prunings. Date Growers' Inst. Rep. 24: 8-9.
8. Furr, J.R. & A. Cook (1952): Nitrogen content of Pinnae, fruit and seed of Deglet Noor and Khadrawy date Palm as related to nitrogen fertilization. Date Growers' Int. Rep. 29: 13-14.
9. Haas A.R.C. (1935): Inorganic composition of date fruit. Date Growers' Inst. Rep. 12: 6-8.
10. Haas,A.R.C. (1947): Varietal differences in the calcium magnesium, poteassium and total phosphorus content in pannae of date palm. Amer. Soc. Hort. Sci. Proc. 50: 200-202.
11. Hussein, F. & A.A.El-Zeid (1975): Chemical composition of "Khalas" date grown in Saudi Arabia. Egypt. J. Hort. 2 (2): 209-214.
12. Hussein, F., S. Moustafa, F.El-Samiraie & M. Mahdi, (1977): Effect of nitrogen fertilization on growth, yield and fruit quality of dates grown in Saudi Arabia. Zagazig J. Agric. Res. 4: 1-16.
13. Kamel, B.S., M.F. Diab, M.A. Ilian & A.J. Salman (1981): Nutritional value of whole dates and date pit in broiler rations. Poultry Science 60: 1005-1011.
14. Labanauskas, C.K. & R.W. Nixon (1962) Concentration of nutrient in pinnae of date palm leaves in relation to unexplained die-back of leaves in Coachella Valley, Californaia. Date Growers' Inst. Rept. 39: 14-15.
15. Minessy, F.A., M.A.A. Bacha & E.M. El-Azab (1974) Seasonal changes in some macronutrient elements in the foliage of four soft date palm varieties grown in Egypt. Alex. J.Agric. Res. 22: 293-299.
16. Minessy: F.A., M.A.A. Bacha & E.M. El-Azab (1975). Changes in Sugars and nu-

trient elements contents in fruit of four soft date varieties in Egypt. Alex. J. Agric. Res. 23: 301-306.

17. Pillai, N.G. and T.A. Davis (1963): Exhaust of macro-nutrient by coconut palm. – a preliminary study. Indian Coconut J. 16 (2): 81-87.
18. Reuther, W. (1948). The mineral composition of date palm foliage. Proc. Amer. Soc. Hort. Sci. 51: 137-144.
19. Reuveni, O. (1971): Trickle irrigation of date palms. Date Growers' Inst. Rep. 48. 16-17.
20. Shawky, K. and M.G. Mougheth (1974): Mineral content of date palm leaves. Egypt. J. Hort. 2: 215-226.
21. Yousif, A.K., N.O. Benjamin, Rado Amin, Mehi Addin, S.& Ali S. (1982): Chemical composition of four Iraqi date cultivars. Date Palm J. 1 (2): 285-294.

Table 1

Fresh and dry weights of flesh and seed per fruit, strands and stalk per bunch and pinnae and rachis per leaf, and amounts of dry matter produced per palm per year.

	FRUIT						Strands and Stalk			LEAF			Total Palm Year
	Khalal Stage			Rutab Stage									
	Flesh	Seed	Total	Flesh	Seed	Total	Strands	Stalk	Total	Pinnae	Rachis	Total	
Fresh Weight (g).	7.2	1.5	8.6	7.6	1.3	8.9	507	1186	1693	1295	1876	3171	
Dry Weight (g).	2.9	1.1	4.0	3.9	1.0	4.9	222	378	600	678	693	1371	
Dry matter (%)	40.1	65	46.5	51.8	73.8	55.3	44	30.2	35.4	51.8	36.9	43.2	
Dry matter/Palm/year* kg	29	11.0	40	39.0	10.0	49.0	2.2	3.8	6.00	13.6	13.9	27.4	82.4
Percent of total	—	—	—	47.3	12.1	59.4	2.6	4.6	7.3	16.5	16.8	33.3	100

★ Values reported are rounded numbers.

Table 2

Mineral composition of the different parts of Tabuuni date palm (on dry weight basis).

Element	Fruits						Strands and Stalk of bunch			Leaf		
	Khalaal Stage			Rutab Stage								
	Flesh	Seed	Whole fruit	Flesh	Seed	Whole fruit	Strands	Stalk	Whole strands and stalk	Pinnae	Rachis	Whole leaf
						PERCENT						
Nitrogen	0.435^{c}	0.940^{b}	0.568	0.441^{c}	1.001^{b}	0.550	0.353^{cd}	0.260^{de}	0.290	1.160^{a}	0.185^{de}	0.670
Phosphorus	0.051^{cd}	0.121^{a}	0.069	0.047^{d}	0.125^{a}	0.063	0.062^{c}	0.027^{e}	0.039	0.082^{b}	0.024^{e}	0.059
Potassium	1.040^{a}	0.196^{de}	0.817	0.754^{b}	0.169^{de}	0.646	0.430^{c}	1.108^{a}	0.857	0.071^{e}	0.366^{cd}	0.220
Calcium	1.63^{cd}	0.145^{d}	0.162	0.130^{d}	0.125^{d}	0.129	0.333^{b}	0.253^{bc}	0.283	0.533^{a}	0.479^{a}	0.506
Sodium	0.0046^{d}	0.0034^{d}	0.0043	0.0043^{d}	0.0037^{d}	0.0045	0.0827^{b}	0.075^{b}	0.078	0.074^{b}	1.42^{b}	0.108
Ash	3.39^{c}	—	3.39	2.47^{c}	—	2.47	7.75^{b}	9.34^{a}	8.75	6.51^{b}	7.35^{b}	6.93
						P P M						
Iron	21.1^{c}	18.9^{c}	20.5	26.9^{c}	22.8^{c}	26.1	165.9^{a}	38.5^{c}	85.6	255^{a}	41.2^{c}	146.4
Manganese	5.7^{c}	9.7^{c}	6.8	5.1^{c}	9.6^{c}	6.0	6.7^{c}	1.6^{c}	3.5	44^{a}	18.9^{b}	31.3
Zinc	3.6^{d}	22.2^{bc}	8.5	3.8^{d}	24.6^{b}	7.9	19.4^{bc}	15.7^{c}	17.1	32.6^{a}	23.3^{b}	27.9
Copper	3.3	5.1	3.9	3.7	6.1	4.2	—	—	—	—	—	—

Means in each row followed by the same letter are not signifficantly different at $P = 0.05$ according to Duncan's multiple range test.

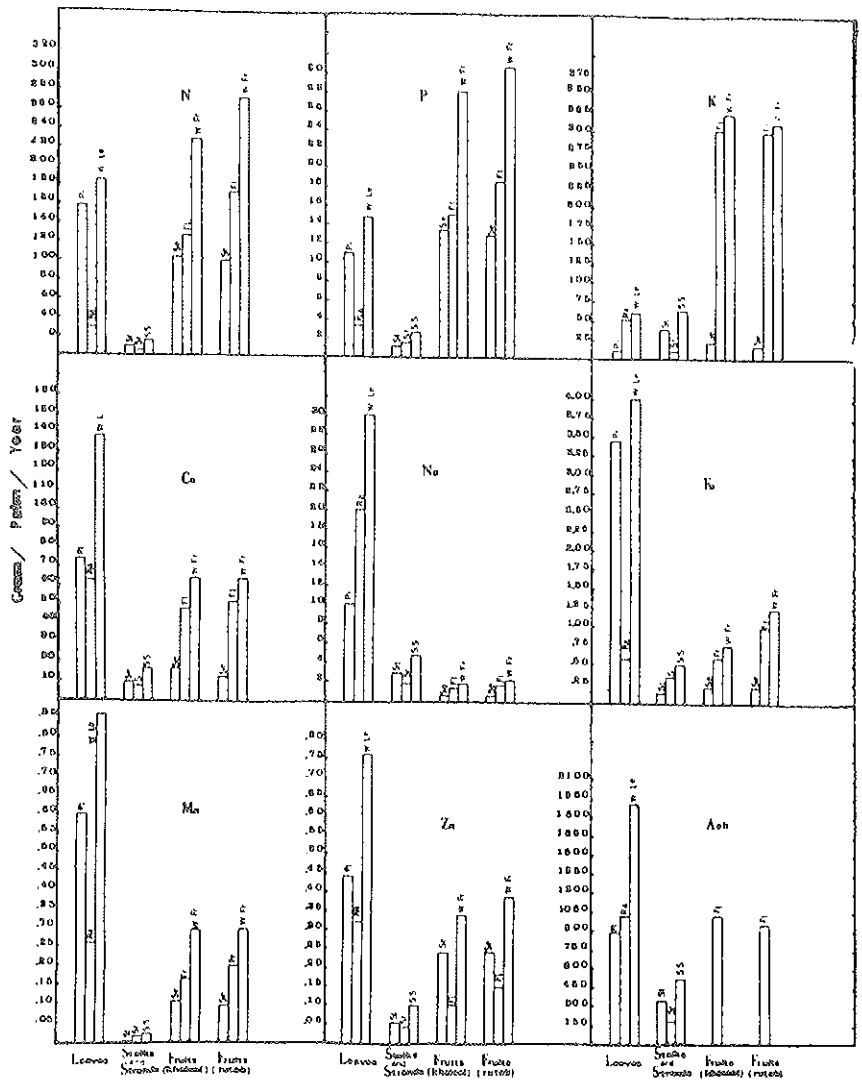


Figure 1: Estimated amounts of minerals, per palm, per year, removed by the different parts of fruit bunch and leaf prunings of date palm tree (F = Flesh; Se = Seed; WF = whole fruit; Sr = Strands; St = Stalk; P = Pinnae; R = Rachis; WL = whole leaf).

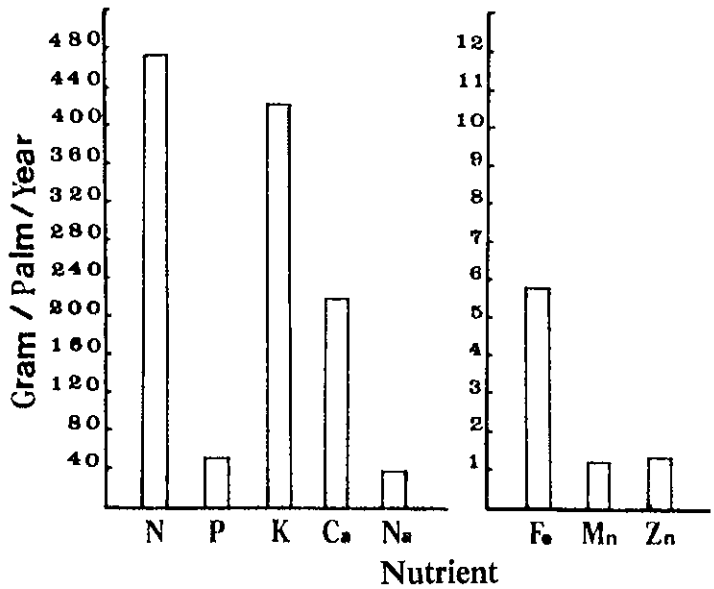


Figure 2: Total amounts of minerals annually lost in fruit harvest and leaf prunings of one date palm tree.

Date Palm J 3 (1): 291 – 301
Published 1984

STUDIES ON CHLORINATION OF PROTOLIGNIN OF FROND BASES (KARAB) OF DATE PALM LEAF (ZAHDI CULTIVAR).

V.TH. BUKHAEV*, and H.S. SABARWAL

Department of Palms and Dates, Agriculture and Water Resources
Research Centre, Fudhaliya, Baghdad, Iraq.

ABSTRACT

The present investigation deals with the chlorination of protolignin for different periods. Frond bases dust has been analysed for its chemical composition (ash, cold water solubility, hot water solubility, 1% NaoH solubility, alcohol: benzene (1: 2) solubility, lignin, cellulose (C and B), holocellulose, elemental (C,H,O,N) and methoxyl groups). The presence of nitrogen in the frond base dust indicates the presence of proteinous material. The yields of crude and pure chlorolignins are presented. The chlorolignin samples were analyzed for their elements and groups. The infrared spectra of chlorolignins were employed to study the presence of groups qualitatively. The infrared spectra for all four chlorination times do not show marked differences. Phenolic, hydroxyl, aliphatic C-H groups and keto groups are identified in the curves.

★ present address, Cellulose Research Unit, Scientific Research Council, Jadhariyah, Baghdad, Iraq.

دراسة كلورة البروتولكنين المستخرج من كرب النخيل (صنف الزهدي)

فيوليت بوخاييف* وهـ . س . سبهاروال
قسم النخيل والتمور، مركز البحوث الزراعية والموارد المائية
فضيلية، بغداد ـ العراق

الخلاصة

تناول البحث كلورة البروتولكنين لفترات مختلفة . وقد تم تحليل مطحون قاعدة السعفة الى مكوناتها الكيمياوية وتشمل نسبة الرماد ـ قابلية الذوبان في كل من الماء البارد والحار، محلول 1% من هيدروكسيد الصوديوم ـ محلول 2:1 كحول بنزين ـ نسبة اللكنين ـ نسبة السليلوز (B,C) الهلوسليلوز ـ نسبة العناصر (الكاربون ـ الهيدروجين ـ الاوكسجين ـ النيتروجين) ومجموعة الميثوكسيل . وقد كان وجود النيتروجين في مطحون قاعدة السعفة دلالة على وجود مواد بروتينية . وجدت نواتج الكلورلكنين الخام والنقي ـ وتم تحليل نماذج الكلورولكنين أي عناصرها ومجموعاتها ـ استعملت الاشعة تحت الحمراء للكلورولكنين لدراسة المجموعات نوعياً ولم يلاحظ اختلاف ملموس في الاشعة عند تطبيق عملية الكلورة اربعة مرات متتالية . عرفت مجموعات الفينول، الهيدروكسيل، الكاربون هيدروجين الاليفاتي ـ ومجموعات الكيتون من المنحنيات .

INTRODUCTION:

Date palm trees constitute a potentially large source of raw material for the manufacture of pulp and paper in the form of leaves. The leaf comprises of mainly three parts, commonly known as frond bases (Karab), frond midrib (Sak Saafa) and leaflets (Saaf). The number of frond bases

---

* العنوان الحالي : وحدة السليلوز ـ مجلس البحث العلمي، الجادرية، بغداد ـ العراق .

(Karab) going to waste is estimated at 210 million annually, and this can be made available for more useful purposes. If proper attention is given, they could be successfully used as a source for pulp and paper manufacture (1).

It is a well known fact that the production of pulp and paper from any fibrous raw material basically involves the removal of lignin. The removal of lignin or delignification is accomplished by subjecting the raw material to cooking or bleaching processes. Cooking and bleaching are carried out separately in order to reduce the severity of the reaction if the delignification is attempted in one step.

It could be possible to remove most of the lignin only by cooking but then it has to be carried out so close to completion that it would degrade the hollocellulose fraction drastically. The resulting cellulose would then be of a considerably shorter chain length, making it inferior for the manufacture of paper. Therefore, it is the lignin only that has to be removed by chemical processes like cooking or bleaching.

The process of bleaching employs the use of chlorine either in the gaseous form or in the form of hypochlorite. The chlorine reacts with lignin and the chlorolignins thus formed are alkali-soluble.

The available literature on pulping and bleaching reveals that most of the work has been done on soft wood and very little work on hard wood lignins (15). Monocots have received very scant attention. From the survey of the literature, it is evident that no work has been done on the chemical structure of lignin from date palm tree leaf. Therefore, we have undertaken the present investigation with the objective of studying the reaction of chlorine which might help in understanding the bleaching process.

MATERIALS AND METHODS

Preparation of raw material: Frond bases of leaf of date palm of Zahdi cultivar were obtained from Zafaraniya experimental station near Baghdad. The tree from which the samples were taken was about 50 years old. The frond bases were air dried and converted into dust and passed through the sieves of different mesh as required according to each analysis.

Proximate chemical analyses: The proximate chemical analyses of frond

dust which included ash content (2), cold water solubility (3), hot water solubility (3), 1% NaoH solubility (16), ether solubility (17), alcohol: benzene solubility (18), lignin content (4), holocellulose content (5), cellulose content (6), was carried out employing TAPPI standard methods.

Preparation of extractive free dust: About 300 g. dust was extracted in a Soxlet apparatus using a mixture of alcohol: benzene (1:2) for 48 hours. The extracted dust was next treated with hot water at 60°C for 2 hours, filtered and air dried. This was next extracted with diethyl ether for 8 hours in a Soxhlet apparatus, washed with hot water at 60°C for 2 hours, filtered and dried.

Preparation of chlorine water: The chlorine water was prepared by bubbling chlorine gas through cold water. The strength of chlorine in the water was estimated by the method described in the pulp and paper manufacture Vol. I (12).

Chlorination of extracted dust: 20 g. dust (passing through 60 and retained at 80 mesh) was placed in a conical flask containing 1.5 litre chlorine water. The content of chlorine was 7.26g/L in all the experiments. Four sets of chlorination were carried out at room temperature (about 20°C) for 4, 6. 24 and 48 hours respectively.

Isolation of chlorolignins: Upon completion of the reaction after each period of chlorination, the dust was filtered and washed with distilled water till free of chloride ions. The completely washed dust was dried in a desiccator and then extracted with absolute alcohol in a Soxhlet apparatus. The alcoholic extract was then poured into ice cold distilled water for precipitation. The precipitate thus obtained from each set of chlorination was filtered and washed thoroughly with ice cold distilled water. The crude chlorolignin thus obtained was weighed.

Purification of chlorolignins: The crude chlorolignin was purified by dissolving it in absolute alcohol and pouring into ice cold distilled water to reprecipitate the chlorolignin. This was filtered and dried. The same procedure was repeated (twice) to get the preparation purified as far as possible. The purified chlorolignins were then dried and weighed.

The purified chlorolignins were stored in brown glass stoppered bottles for further analyses.

Analyses of chlorolignins:* The chlorolignins were analysed for their elements carbon, hydrogen and chlorine. The original dust was analysed also for the nitrogen and methoxyl contents. The methoxyl content of the dust was confirmed by analysis in our laboratory (18). The Infrared spectra of all the chlorinated protolignins were determined by Nujol mull technique by B.M.A.C.*.

RESULTS AND DISCUSSIONS:

Table 1 presents the proximate chemical analysis of frond bases. The ash content is high as compared with other species of soft or hard woods. The cellulose content of 29.30% suggests its suitability for use as a raw material for the manufacture of pulp and paper.

A perusal of Table II indicates the presence of nitrogen. There is little difference between the results of elemental analysis of frond bases when compared with the average results reported by Rydholm (13) and "Encyclopedia of chemical technology" (11) for different species of wood.

Table III shows the yields of chlorolignins obtained after different periods of chlorination. The yield of five chlorolignins goes on decreasing with the increase in time period barring one anomalous result obtained after 24 hours of chlorination. The gradual decrease in the yields is probably due to degradation after a certain length of time, the already chlorinated lignin fraction (10) with the degraded fraction going into solution.

Table IV indicates the loss in methoxyl content with the increase in chlorine content. Demethylation during chlorination is consistent with the results reported for other kinds of wood (14). Methoxyl content of the original frond sample is 4% on an oven dry basis. Since the methoxyl group is present solely in lignin, the methoxyl content of lignin should

---

★ The analyses were carried out by the Butterworth Microanlytical Consultancy limited 41, High Street, U.K.

theoretically be 14.69% based on the lignin content of 27.23% in the original sample . The directly determined metho yl content of isolated lignin from frond bases dust is 19.67%.

Reference to Table 3 and Table 4 would indicate that the organically bound chlorine recovered as chlorolignin ranges from 0.147g (48 hours chlorination) to 0.393 g. (24 hours chlorination). However, 10.88 gm of chlorine is used in the chlorination of each 20gm powdered frond base sample. Therefore, it is apparent that the rest of the chlorine has either passed into the water soluble chlorolignin fraction or been consumed in other oxidation reactions (8).

The infrared spectra for the chlorinated protolignins obtained by the Nujol technique are presented in Figure 1. The Infrared spectra for all four chlorination times show similar absorption bands. The band at 3400 Cm^{-1} indicates the presence of phenolic hydroxyl groups 7. Normally the absorption due to this group arises at 5400 Cm^{-1} but the shift can be attributed to the presence of chlorine atoms in the molecule. The band in the region of 2900 Cm^{-1} is due to aliphatic C-H groups (9). The band at 1720 to 1700 Cm^{-1} indicates the presence of –keto or carbonyl groups (14).

LITERATURE CITED

1. Al-Zubaidy, A.F.; V. Th. Bukhaev. F.S.Zaki & J.A.Sarkis (1975) : Ash, Moisture and Solubilities in several solvents of different parts of date palms. Second Scientific Conference. Baghdad, Iraq.
2. American Society for Testing and Materials (ASTM) (1956a): Standard method of test for ash in wood. ASTM designation D 1102-56. Annu. Book ASTM. Part 16, 380 p. (Reapproved 1966).
3. American Society for Testing and Materials (ASTM) (1956): Standard method of test for water solubility of wood. ASTM designation D 2016-65. Annu. Book ASTM Stand. Part 16. 660p.
4. American Society for Testing and Materials (ASTM) (1956c): Standard method of testing lignin in wood. ASTM designation; D 1106-56.
5. American Society for Testing and Materials (ASTM) (1956b): Standard method of test for holocellulose in wood. ASTM designation: D 1104-56 Annu. Book ASTM Part 16, 371 (reapproved 1966).
6. American Society for Testing and Materials (ASTM) (1956): Standard method of test for alpha-cellulose in wood. ASTM designation D 1103-60. Annu. Book ASTM Stand. Part 16; 365 p. (Reapproved).
7. Bolker, H.I. & N.G. Somerville (1963): Chlorination of lignins, Pulp Paper Mag. Can. 64: 187.
8. Brauns, F.E. (1952): The chemistry of lignin, Academic Press, New York, 744 pp.
9. Browning, B.L. (1977): Methods of wood chemistry. Inter-science Publishers. Vol. II, 750 pp.
10. Giertz, H.W. (1951): TAPPI, 34, 209 p.
11. Kirk-Othmer (1970): Encyclopedia of chemical technology. Interscience Publishers, 364 p.
12. MacDonald, R.G. (1969): Pulp and paper manufacture; McGraw Hill Book Company, 22 p.
13. Rydholm, S.A. (1965): Pulping process, Interscience Publishers, New York, 90 p.
14. Sarkanen, E.V.& C.H. Ludwig, (1971): Lignins, Wiley – Interscience Publishers, 409 p.
15. Singh, R.P. (1979): The bleaching of pulp, TAPPI Press, New York 33 – 40.
16. Technical Association of the Pulp and Paper Industry (TAPPI) (1959): One percent caustic soda solubility of wood. TAPPI Test Proced., T 40-59.
17. Technical Association of the Pulp and Paper Industry (TAPPI) (1954): Ether solubility of wood. TAPPI Test Proced., T 5M-54.
18. Technical Association of the Pulp and Paper Industry (TAPPI) (1973): Alcohol-benzene solubility of wood. TAPPI Test Proced., T 6W Od-74.
19. Technical Association of the Pulp and Paper Industry (TAPPI) (1975): Methoxyl groups of wood. TAPPI Test Proced. T wd – 72b.

Table 1

Results of proximate chemical analyses of frond bases of date palm leaf of Zahdi cultivar.

Contents	% on the basis of extractive free oven dried samples
Ash	10.86
Cold water solubility	13.70
Hot water solubility	17.19
1% NaOH slubility	40.86
Ether solubility	00.54
Alcohol: Benzene solubility	06.00
Lignin	27.23
Cellulose (C and B)	29.30
Holocellulose	56.60

Table 2

Elemental and functional group analyses of frond bases dust (Mean of two samples).

Contents	% on dry weight		
	frond bases	0	00
Carbon	39.96	50.00	49.10
Hydrogen	05.08	06.08	06.15
Nitrogen	00.14	00.3	0.1 – 0.3
Oxygen (by difference)	54.82	44	44.8
Methoxyl	04.05		
Methoxyl	04.00*		

0 The elementary composition of many species (Average) of wood reported by S.A. Rydholm

00 The elementary composition of many species (Average) of wood reported in the Encyclopedia of Chemical Technology (Interscience Publishers, 1970).

★ Carried out in the Center's laboratory.

Table 3

Yields of chlorolignins from protolignin of the frond bases.

Period of chlorination (hours)	% expressed on the bases of extracted oven dry samples	
	Crude yield %	Pure yield%
4	8.719	7.506
6	10.910	6.427
24	10.887	10.708
48	8.420	4.094

Table 4

Elemental and functional group analyses of chlorolignins (Mean of two determinations).

Hours of chlorination	Carbon %	Hydrogen %	Chlorine %	Oxygen* %	Methoxyl %
4	46.58	3.83	16.97	32.61	7.88
6	45.98	3.65	16.97	33.55	7.13
24	45.11	3.52	18.39	32.97	6.99
48	47.27	4.21	17.95	30.60	6.79

★ Oxygen percentage by difference.

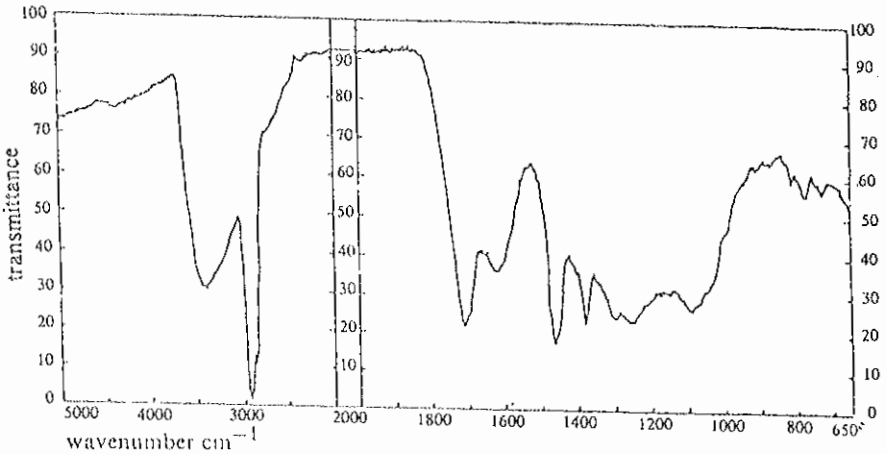


Figure 1: Infrared spectrum of chlorinated protolignin (4 hours).

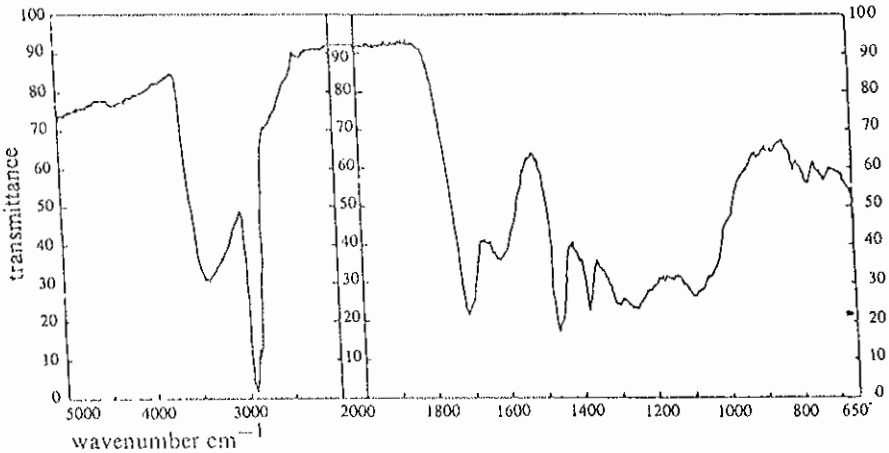


Figure 2: Infrared spectrum of chlorinated protolignin (6 hours).

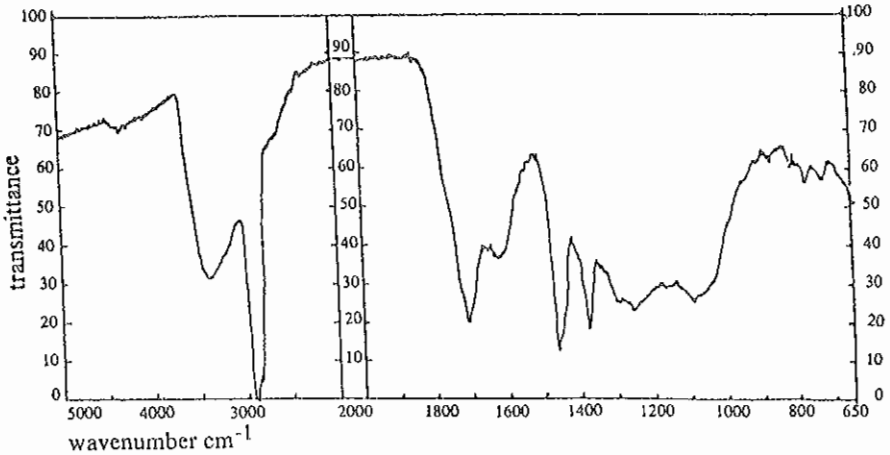


Figure 3: Infrared spectrum of chlorinated protolignin (24 hours).

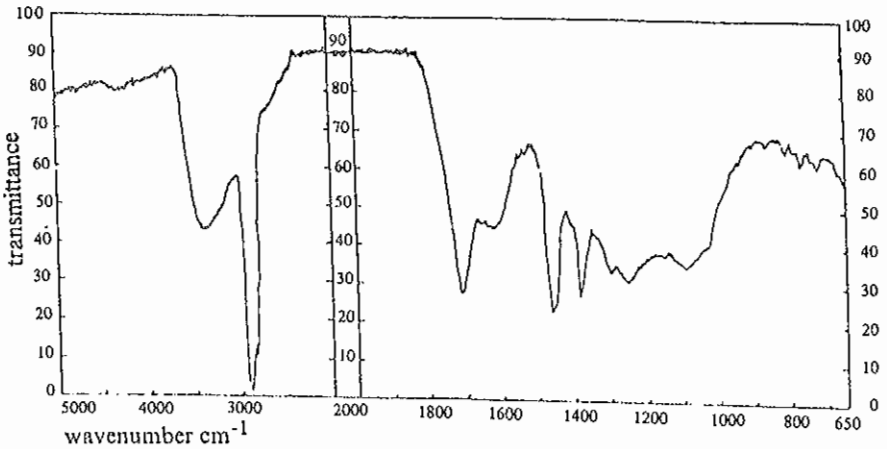


Figure 4: Infrared spectrum of chlorinated protolignin (48 hours).

Date Palm J 3 (1): 303 – 316
Published 1984

DARKENING OF DATES: CONTROL BY MICROWAVE HEATING

H.H. MUTLAK

Department of Palms and Dates, Agriculture and Water Resources Research Centre, Fudhaliya-Baghdad, Iraq.

J. MANN

Loughborough University of Technology, England

ABSTRACT

The activity of polyphenolase and peroxidase has been determined in two varities of dates (Zahdi and Khadrawi) before and after the treatment by microwave heating. The changes in colour, total soluble phenolic compounds and tannin have also been investigated. Polyphenolase was more active in the fully ripe dates than the green dates. Microwave heating for 1 minute was sufficient for complete inactivation of polyphenolase in both fully ripe and green dates. Peroxidase was completely inactivated in the fully ripe dates by microwave heating for less than 1 minute. Further, the results show that the insoluble leucoanthocyanidin tannin is responsible for darkening of dates in fully ripe dates.

دكنة التمور/السيطرة عليها باستخدام حرارة المايكروويف

حمود هادي مطلك

قسم النخيل والتمور، مركز البحوث الزراعية والمواد المائية

الفضيلية، بغداد ـ العراق

جون مان

جامعة لفبرة التكنولوجية ـ انكلترا

الخلاصة

لقد تم تقدير فعالية انزيمي البولي فينوليز والبيروكسيديز في صنفي الزهدي

والخضراوي قبل وبعد معاملة التمور بحرارة المايكروويف . وكذلك تمت دراسة التغيرات باللون والمركبات الفينولية الذائبة الكلية والتانين .

اتضح من النتائج ان فعالية انزيم البولي فينوليز بالتمور الناضجة أعلى من فعاليته بالتمور غير الناضجة . لقد تم تثبيط انزيم البولي فينوليز تماماً بالتمور الناضجة وغير الناضجة بواسطة حرارة المايكروويف لمدة دقيقة بينما تم تثبيط انزيم البيروكسيديز بالتمور الناضجة بواسطة حرارة المايكروويف لمدة أقل من دقيقة . أوضحت النتائج بأن التانين غير الذائب مسؤول عن اسوداد التمور الناضجة نتيجة لتأكسده .

INTRODUCTION

The deterioration of dates in storage is a major problem and results in undesirable changes in appearance, taste and food value of the fruit. There are several types of deterioration during storage. The most common types of deterioration are darkening, insect infestation, sugaring and microbiological spoilage (11).

Three types of reaction are involved in the darkening of dates: –

i) Enzymatic oxidative browning of simple phenolics such as derivatives of flavan-3,4 – diol, and dactylifric acid (3-O-caffeoylshikimic acid (7,8).

ii) Non-enzymatic oxidative browning of tannin material such as the polymers formed from flavan-3,4- diol derivatives. This polymeric material, which is normally referred to as leucoanthocyanidin tannin, can be either soluble tannin, normally 2 to 8 units in the polymer, or insoluble tannin, more than 8 units in the polymer. The soluble tannin is responsible for astringency. The insoluble tannin appears to be the material involved in the non-enzymatic oxidative browning (4,6).

iii) Non-enzymatic, non-oxidative browning of reducing sugars (15).

Enzymes, such as polyphenolase and peroxidase, are often responsible for the production of undesirable colours, flavours and textures during storage of foodstuffs. Blanching is frequently used to destroy the enzymes in foodstuffs; care has to be taken when using water or steam blanching in order to prevent leaching of nutrients and flavour compounds. A com-

parison of the use of microwave heating with boiling water for blanching whole potatoes has been undertaken (2). The results suggested that microwave heating could be effectively utilized for blanching. Another study has been carried out using microwave blanching of peaches before freezing (1).

Dates artificially matured by freezing are in general of good quality except that they are dark in colour and the darkening reactions produce some slight off-flavour. The darkening occurs only slightly during the freezing period but rapidly during thawing period. If the darkening and consequent production of off-flavours could be prevented, then the use of freezing for artificial maturation and storage could become of great commercial importance.

This investigation was, therefore, carried out to study the chemical changes related to the darkening that occurs during freezing and storage of dates, particularly the changes in total soluble phenolic compounds, insoluble leucoanthocyanidin tannin and total soluble solids. The use of blanching both by water and microwave in order to prevent the darkening of dates was also investigated.

MATERIALS AND METHODS

Extraction Procedures

The method of Maier and Metzler was used to extract phenolic compounds from dates (6). In the extraction, 50g were used instead of 100g as stated in this method and half the amount of all reagents was used.

Analytical Methods

Determination of moisture: The Bidwell and Sterling method was used for moisture determination (3). Between 3 and 10g on sample of dates was used for the determination depending on stage of ripeness of the dates.

Titratable acidity: The titratable acidity, expressed as grams of tartaric acid/100g dates, was determined by titrating the extract against 0.1M NaOH using phenolphthalein as indicator (12).

pH: The pH reading was measured using a standard pH meter and glass electrode.

Total soluble solids: The total soluble solids (TSS) were measured using a hand refractometer.

Soluble phenolic compounds: The total soluble phenolic compounds and soluble leucoanthocyanidin tannin were determined according to the method of Swain and Hillis (16). The Folin-Denis and sodium carbonate reagents were prepared according to the published procedure (5). Calibration curves were prepared for the determination in dates the amount of total soluble phenolic compounds and soluble leucoanthocyanidin tannin expressed as (+) catechin or as tannic acid.

Insoluble leucoanthocyanidin tannin: The insoluble leucoanthocyanidin tannin was determined according to the method of Maier and Metzler (6). The published extinction coefficient of 29270 was used to calculate the amount of insoluble leucoanthocyanidin tannin present (13).

Colour: The colour intensity was measured by taking 20cm^3 from the extract and the pH was adjusted to 6.3 by adding an appropriate amount of 4m acetate buffer. 1cm^3 of this extract was diluted to 100cm^3 with distilled water and the absorbance was measured using a UV/Visible spectrophotometer at 270 nm (1cm path cell).

Procedures to inactivate the enzymes in dates: Zahdi variety (green stage and tamar stage – fully ripe) and khadrawi variety (tamar stage – fully ripe) were used for this investigation. The enzymes, polyphenolase and peroxidase, were inactivated by treating dates in a microwave oven (AKB 104 – 8105 – 1.6Kw). Usually 7 dates were treated in the microwave oven, for varying lenghts of time of 0, 10, 15, 20, 30, 40, 50, 60, seconds. The temperature was measured inside dates before and immediately after taking the dates out of the oven using thermocouples. The dates were allowed to cool to room temperature and then packed in LDPE bage.

Dates were also blanched in boiling water for 0, 1, 2, and 3 minutes. The variety of dates used for this investigation was Zahdi dates (Tamar stage – fully ripe). The temperature was measured inside the dates before and during immersion in boiling water using thermocouples.

Measurement of enzyme activity in dates: Polyphenolase and peroxidase activities were assayed by a spectrophotometric method according to the Maier and Schiller method (10). The absorbance measurements were made at 20 second intervals on a recording spectrophotometer. Catechol was

used as a substrate for determining polyphenolase activity. Guaiacol and hydrogen peroxide were used to determine peroxidase activity. For measuring polyphenolase activity, absorbancy measurements were carried out at 410nm (1cm path cell). For measuring peroxidase activity, measurements were taken at 400nm (1cm path cell).

RESULTS AND DISCUSSION

The effects of microwave heating on the chemical composition of dates have been shown in tables 1, 2, 3, and Fig. 1. The moisture content of dates was found to decrease after microwave heating. However, the decrease was slight in the tamar stage but considerable in the green stage, this reflecting the higher initial amount of moisture in the green stage which exist as free water.

There were no significant changes in pH following microwave treatment of the dates. The total soluble solids slightly decreased as the temperature increased. This decrease might have been due to the non-enzymatic, non-oxidative browning reactions between sugars and amino acids (15). The increase in total soluble solids in the green dates may have been due to the break down of pectic substances and cellulose during microwave heating. The increase in the colour intensity in the green dates could have been due to the breakdown of chlorophyll during microwave heating treatment.

The results show that the total soluble phenolic compound decreased as the temperature increased and reached a minimum at a particular temperature depending on the variety of dates. Then the amount of phenotic compounds increased as the temperature increased and reached a maximum. The changes in soluble phenolic compounds were probably due to the activity of polyphenolase during the microwave treatment. When the green dates were treated by microwave heating, the amount of soluble phenolic compounds decreased as the temperature increased. The decrease could have been due to the changes in soluble leucoanthocyanidin tannin.

The soluble tannin was found to decrease as the temperature increased. This decrease could be related to the conversion of soluble tannin into insoluble tannin. The insolubility of tannin could be due to its large molecular size or to interaction with other insoluble tissue fractions such as cellulose, pectin, hemicallulose or protein (7). The slight decrease in the total soluble

phenolic compounds in the fully ripe dates was more likely caused by the activity of the polyhenolase rather than by the conversion of soluble tannin into insoluble tannin. The Folin – Denis method gave a high value in measuring the amount of soluble tannin in the ripe and fully ripe dates. The high value was probably due to the presence of new compounds in the ripe and stored dates and the absence of these compounds in the green dates (16). The conversion of soluble tannin into insoluble tannin was more likely than the use of soluble tannin as a substrate for the polyphenolase.

The amount of insoluble leucoanthocyanidin tannin decreased as a result of the microwave heating. This decrease was probably due to breakdown of insoluble leucoanthocyanidin tannin during the treatment. Therefore., it appeared that insoluble leucoanthocyanidin tannin of Khadrawi dates was more susceptible to breakdown than in Zahdi dates. This might explain the reason why Khadrawi dates become dark after ripening and during storage and, Zahdi dates become a reddish-brown colour. This could be noticed in the tissue residue after extraction and drying. These results might explain the reason why the insoluble leucoanthocyanidin tannin appeared to be more susceptible to oxidation than to acting as a substrate for the polyphenolase. No significant oxidation of insoluble leucoanthocyanidin tannin in the green dates was noticed. It would appear, therefore, that insoluble leucoanthocyanidin tannin was more susceptible to oxidation in the fully ripe dates and during storage than in the green dates.

The effects of microwave treatment on polyphenolase and peroxidase activity have been shown in figs 2 and 3. The increase in temperature during the microwave treatment caused an increased in the velocity of reaction between the enzyme and the substrate (9). This can be seen in the changes in soluble phenolic compounds given in tables 2,3. The results show that when the temperature increased further the enzyme was inactivated. The polyphenolase of Zahdi dates in both (green and tamar) was completely inactivated by microwave heating for 1 minute. Polyphenolase has been reported to have been inactivated by blanching in hot water at 100°C for 1.5 minute (14). The polyphenolase test was carried out with green dates by using catechol as a substrate. A dark colour was produced if polyphenolase was still active. To make sure that the polyphenolase was inacti-

vated, samples of green dates in which the enzyme was very active were stored at – 13°C for two months, after half samples were treated with microwave heating for 1 minute. It was found that the untreated dates were darker in colour, but there was no change in the colour of the treated dates. The untreated dates gave darker colour with the polyphenolase test, while the treated dates gave no change in the colour. The polyphenolase was not completely inactivated for 1 minute in Khadrawi dates. This obviously indicated greater polyphenolase activity in Khadrawi dates than in Zahdi dates. Hence, this could explain the darker colour in Khadrawi dates and reddish-brown colour in Zahdi dates in the fully ripe dates.

Peroxidase apparently is less active than polyphenolase during storage or after ripening of dates (10). Peroxidase apparently, therefore, has no effect on the darkening of dates (14). Microwave treatment for 1 minute was not enough to inactivate the peroxidase completely in the green dates as the peroxidase test showed. However, the peroxidase was completely inactivated for less than 1 minute by microwave heating in Zahdi and Khadrawi dates (fully ripe dates). Inactivation of polyphenolase is important to prevent excess darkening but complete inactivation of peroxidase may not be essential. Other workers reported that peroxidase was inactivated at 100°C for 14 minutes (14).

CONCLUSSION

Microwave treatment of dates was found to be efficient in the inactivation of polyphenolase and peroxidase. Only short periods of treatment were necessary compared with long period of blanching in boiling water to inactivate the enzymes. The darkening of dates was reduced when the polyphenolases were completely inactivated by the microwave treatment. Thus microwave heating in the correct dosage, appears to be a very useful method in controlling deteriorative changes in dates during susbsequent storage. A high quality product of good colour, flavour and keeping quality is produced by this treatment. It would appear, therefore, that this method of treatment of dates is worth further investigation and application on an industrial scale. Although initial cost of plant could be high, this could be justified by the production of a high product, whihch after cold storage would be available throughout the year.

LITERATURE CITED

1. Avisse, C. & P. Varoquanx (1977): Microwave blanching of peaches J. of Microwave Power, 12 (1); 73 – 77.
2. Collins, J.L. & I.F. Macarty (1969): Comparison of microwave energy with boiling water for blanching whole potatoes. Food Tech., 23: 377 – 340.
3. Dowson, V.H.W. & A. Aten (1962): Dates: Handling, Processing and Packing. FAO, Rome.
4. Fennema, O.R. (1976): Principles of Food Science (Food chemistry), Part 1. Academic Press, New York and Basel, pp. 412 – 413.
5. Herschdoerfer, S.M. (1972): Quality control in the food industry. Volume 3, Academic press, London, P. 111.
6. Maier, V.P. & D.M. Metzler (1965): Quantitative changes in date polyphenols and their relation to browning. J. of Food Sci., 30: 81 – 83.
7. Maier, V.P. & D.M. Metzler (1965): Changes in individual date polyphenols and their relation to browning J. of Food Sci., 30; 747 – 752.
8. Maier, V.P.; D.M. Metzler & A.F. Huber (1964): 3-O-Caffeoylshikimic acid (dactylifric acid) and its isomers , a new class of enzymatic browning substrates. Biochem. Biophys Res. Comm., 14 (2); 124 – 128.
9. Maier, V.P. & F.H. Shiller (1960): Studies on domestic dates. 1 – Method for evaluting darkening. Food Tech., 14: 139.
10. Maier, V.P. & F.H. Schiller (1961): Studies on domestic dates, 11. Some chemical changes associated with deterioration. J. of Food Sci., 26 (3): 322 – 328.
11. Mark, E.M. 1(941): The deterioration of dates. Date Growers' Inst. Rept. 18; 3 – 4.
12. Mikki, M.S.; W.F. Al-Tai & T.S. Jaafer (1978): Studies on date Jams. 1. Suitability of different commercial date cultivars for Jam making. Palms & Date Research Centre (Baghdad) Tech. Bulletin No. 6.
13. Nordström, C.G. (1956): Flavonoid glycosides of *Dahlia variabilis*. IV. 3 – Glycosido-5- arabinosido cyanidin from the variety "Dandy" Acta Chem. Scand., 10; 1495..
14. Rashid, I.M. (1950): Oxidizing enzymes in dates in relation to the darkening of the fruit. Ph.D. Thesis, Mass. University, Amherst.
15. Rinderknecht, H. (1959): The free amino acid pattern of dates in relation to their darkening during maturation and storage. Food Research., 24; 298 – 304.
16. Swain, T. & W.E. Hillis (1959): The phenolic constituents of Pruns. 1 – The quantitative analysis of phenolic constituent. J. Sci. Food Agr., 10; 64.

Table 1

The effect of microwave heating on Zahdi dates (green stage-whole dates)

Microwave heating time (seconds)	% moistue	pH	% acidity	% TSS	Colour O.D. at 270 nm (1cm cell)
0	74.1	5.6	0.160	6.0	0.294
20	72.8	5.5	0.165	6.0	0.365
30	70.2	5.5	0.167	6.3	0.445
40	67.7	5.3	0.168	6.5	0.612
50	64.3	5.1	0.170	7.0	0.712
60	60.8	5.0	0.171	8.0	0.745

Table 2

The effect of microwave heating on Zahdi dates (fully ripe-whole dates).

Microwave heating time (second)	% moisture	pH	% acidity	% TSS	% Total phenol (a)	% Total phenol (b)	insoluble tannin (c)
0	13.8	5.0	0.170	41.0	202	254	475
15	13.7	5.0	0.172	40.5	187	234	419
20	13.6	5.0	0.175	40.2	186	230	408
25	13.6	5.0	0.176	40.0	186	230	374
30	13.3	4.9	0.183	40.0	191	241	366
40	13.1	4.9	0.185	40.0	205	250	338
50	13.0	4.9	0.187	39.8	200	249	335
60	12.8	4.8	0.188	39.6	205	257	335

(a) Total soluble phenolic compounds calculated as mg (+) catechin/100g dates (dry weight).

(b) Total soluble phenolic compounds calculated as mg tannic acid/100g dates (dry weight).

(c) Insoluble leucoanthocyanidin tannin calculated as mg cyanidin chloride/100g dates (dry weight).

Table 3

The effect of microwave heating on khadrawi dates (fully ripe-whole dates)

Microwave heating time (second)	% moisture	pH	% acidity	% TSS	% total phenol (a)	%total phenol (b)	% Insoluble tannin (c)
0	16.1	5.2	0.170	40.5	239	295	458
10	15.8	5.2	0.174	40.3	227	295	455
15	15.5	5.1	0.180	40.0	216	275	428
20	15.4	5.1	0.183	39.8	226	280	414
25	15.2	5.1	0.185	39.5	231	286	375
30	15.0	5.0	0.190	39.0	236	291	340
40	15.0	5.0	0.192	38.7	236	291	284
50	14.7	5.0	0.195	38.5	235	290	278
60	14.5	4.9	0.198	38.0	234	292	269

(a) Total soluble phenolic compounds calculated as mg (+) catechin/100g dates (dry weight).

(b) Total soluble phenolic compounds calculated as mg tannic acid/100g dates (dry weight).

(c) Insoluble leucoanthocyanidin tannin calculated as mg cyanidin chloride/100g dates (dry weight).

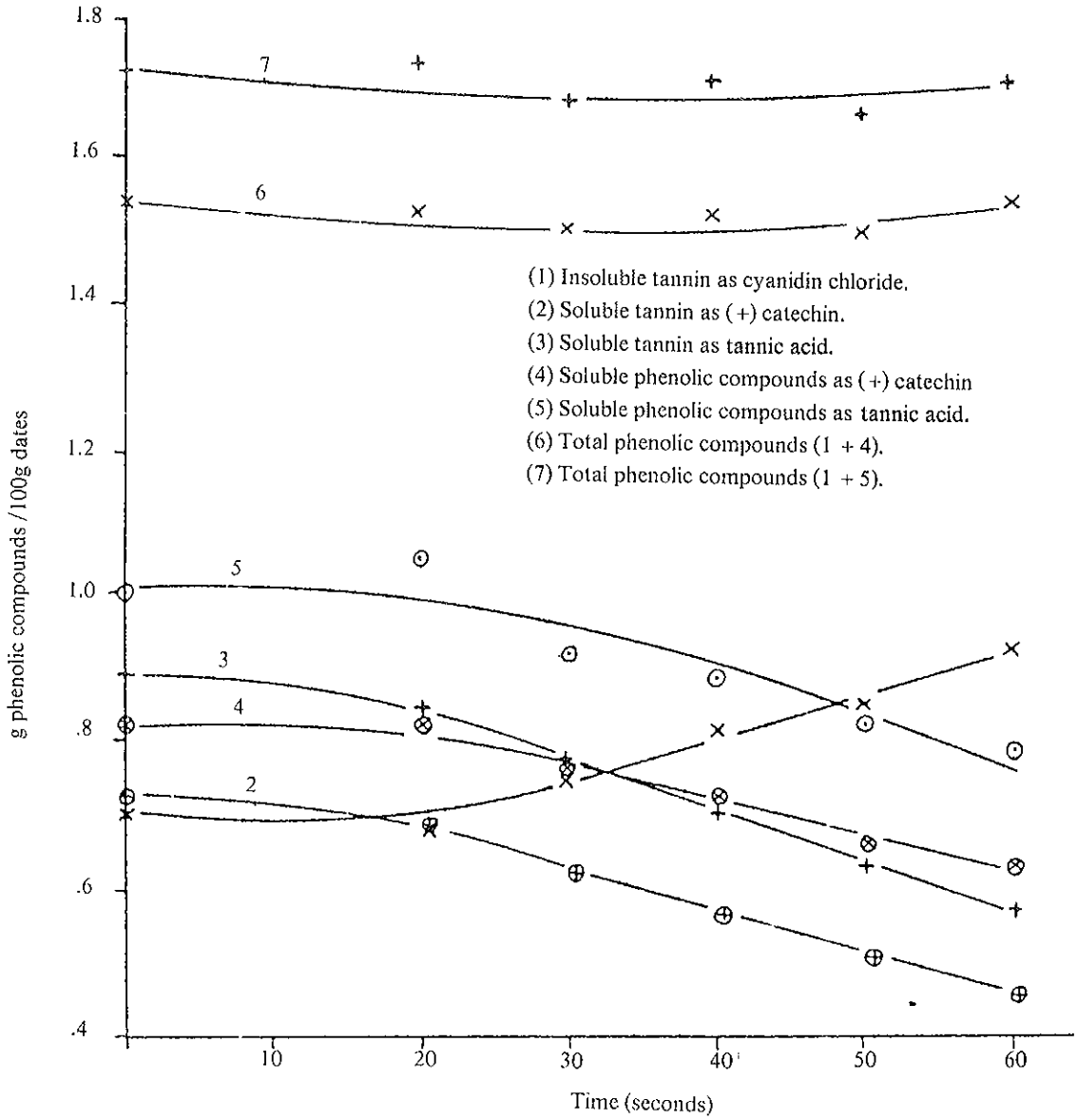


Figure 1: Effect of duration of treatment by microwave on the phenolic compounds in Zahdi dates (green stage).

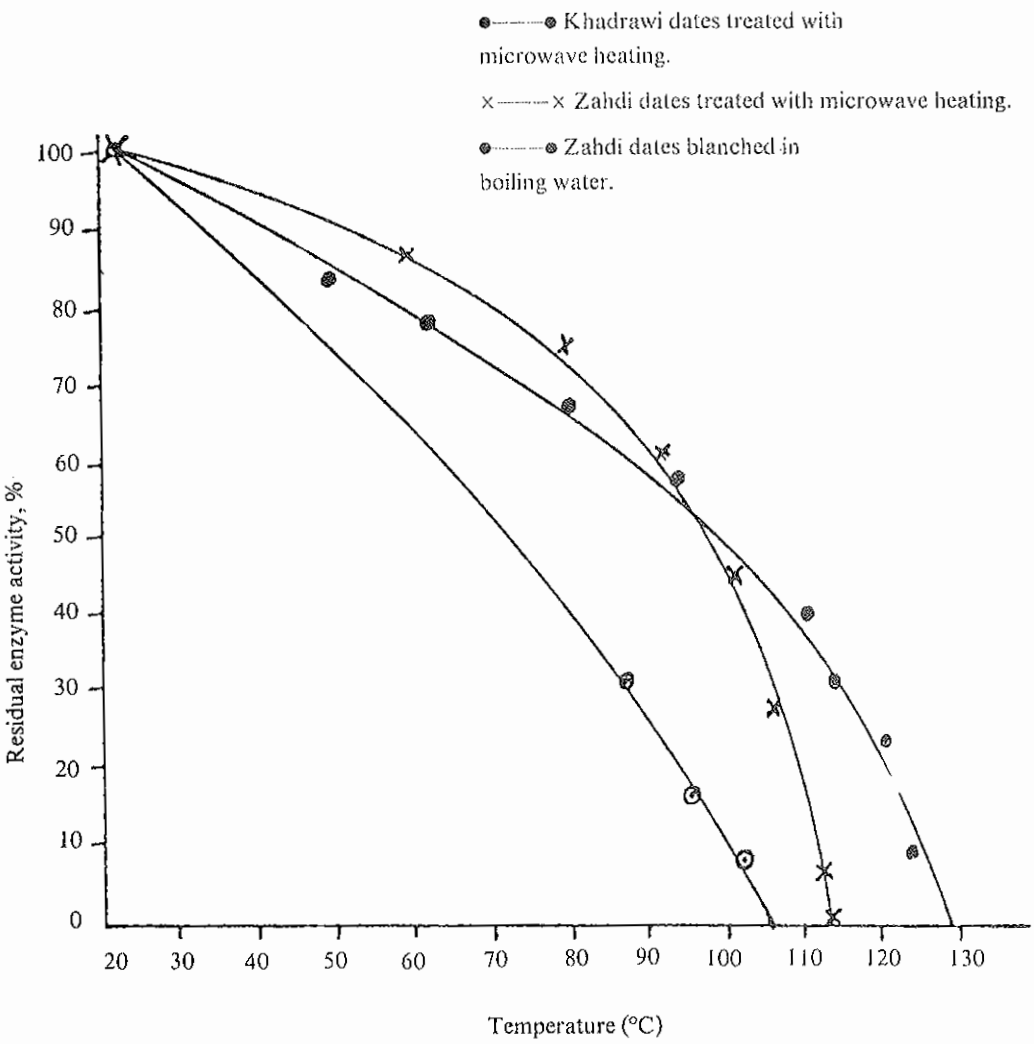


Figure 2: Effect of temperature on polyphenolase activity in dates.

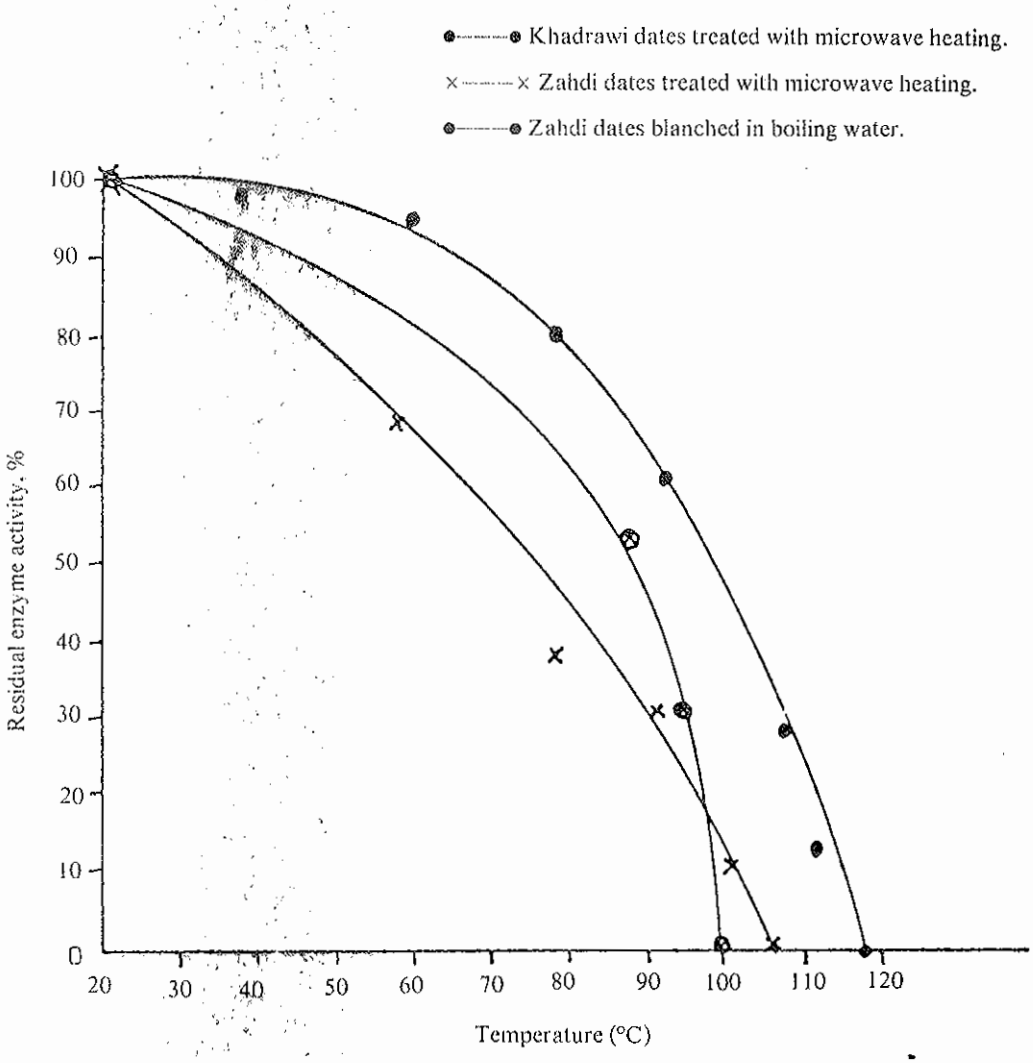


Figure 3: Effect of temperature on peroxidase activity in dates.

Date Palm J 3 (1): 317 – 325
Published 1984

INDUSTRIAL UTILIZATION OF SUDANESE DATES. I. QUALITY OF DATE-JAM AS AFFECTED BY STAGE OF MATURITY

A. EL MUBARAK ALI
Food Research Centre, Shambat
P.O.Box 213, Khartoum North, Sudan
and
A.M.A. OSMAN*
Agricultural Research Corporation, Wad Madani, Sudan

ABSTRACT

The procedure for date pulp extraction from Khalal, Soft and Dry stages of maturity was established. In Khalal and Soft stages water was added at a ratio of 1 to 3 (W/W) after destoning of the fruits, boiled in steam jacketted kettle for 10 – 15 minutes (maintaining the level of water by additional hot water during boiling) followed by pulping. In Dry stage soaking for 2 hours before heating and pulping is necessary. Wide variation in chemical composition of date pulp during the different stages of maturity exists especially in the percentages of total soluble solids and alcohol insoluble solids. Recipies for making jam from each cultivar during the different maturity stages were developed based on the initial chemical composition of the pulp. The Soft stage of maturity was found to be the most suitable maturity stage for date-jam manufacturing, followed by Dry stage.

★ Present address: Regional Project For Palm & Dates Research Centre in the Near East & North Africa c/o UNDP, P.O.Box 2993, Kuwait.

الاستعمالات الصناعية للتمور السودانية

١ ـ مرحلة نضج التمر كعامل مؤثر على جودة مربى التمر

عبدالله المبارك علي
مركز بحوث الاغذية شمبات السودان
عوض محمد عثمان
هيئة البحوث الزراعية ـ واد مدني ـ السودان

الخلاصة

تم شرح طريقة استخلاص العجينة في الخلال والتمور في مراحل النضج الطريقة والجافة. في مرحلة الخلال والتمور الطرية يضاف الماء بنسبة 1 ماء الى 3 وزن تمر منزوع النوى، ثم يغلى في مغلاة محاطة في بخار ماء لمدة 10-15 دقيقة (مع المحافظة على مستوى الماء وذلك باضافة ماء مغلي خلال الغلي) يلي ذلك العجن. وفي حالة تمور في المرحلة الجافة يكون من الضروري نقعها لمدة ساعتين قبل التسخين والعجن. توجد فوارق كبيرة في التركيب الكيمياوي للب التمور خلال المراحل المختلفة من البلوغ وخاصة في نسبة المواد الصلبة الذائبة والمواد الصلبة غير الذائبة في الكحول. ثم تطوير طريقة عمل المربى من كل صنف استناداً على التركيب الكيمياوي الاولي خلال المراحل المختلفة للبلوغ. وجد أن المرحلة الطرية للتمر اكثر مراحل النضج ملائمة لصناعة مربى التمر يليها المرحلة الجافة.

INTRODUCTION

Dates production in Sudan is mainly concentrated in the Northern Region (Northern and Nile Provinces). The annual production of dates was 71750 tons in 1977/78 (3). There is only one date packing house at Karima (Northern Province) with a capacity of 1700 tons per annum (2). Not much attempts were made either within the packing house or in Karima Canning Factory which is located few meters from the packing house to

produce other date products.

A joint research programme is now initiated between Hudeiba Research Station (Horticulture Section) and the Food Research Centre to investigate both horticultural and technological aspects of the different dates cultivars. The procedures for the production of dates based products such as jams, syrup, pulp, caramel colour and canning of dates will be investigated.

In the present study the effect of stage of dates maturity for different types of dates on the quality of jam will be discussed as this product could be produced by Karima Canning Factory as well as by other canning factories. Fruit pulps are often prefered by food industries as ready to use raw materials.

MATERIALS AND METHODS

Eight different date cultivars were chosen for this study. Four of them were picked at Khalal and Soft stages of maturity while the other four were dry type of cultivars and were included in this study for comparison.

Preparation of pulp:

a — Khalal and Soft types: Date pulp was prepared from each variety be adding water to the date at a ratio of 1 to 3 (W/W) after destoning the fruits by hand, then boiled in steam jacketted kettle for 10 – 15 minutes. Additional hot water was added to maintain the level before passing the heated material through a pulper.

b — Dry (Tamar): Dry cultivars as Barakawi were soaked in tap water for two hours, boiled for 30 minutes and pulped as in (a).

Total soluble solids (T.S.S.) was determined by a hand refractomater. PH was determined by a Fisher pH-meter. Titrable acidity (T.A.) was determined by direct titration using phenolphthalein as indicator while sugars were determined by Lane and Eynon method (AQAC) (1). For alcohol insoluble solids (A.I.S.) AOAC method was followed. Presence of date flavour in the pulp was assessed by a group of untrained panelist of Food Research Centre staff.

The recipies shown in Table 2 were developed during this investigation after several trials taking into consideration the chemical composition of the pulp.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of the pulps for the eight cultivars at the different stages of maturity as well as for the dry cultivars. Cultivars were analysed at the Khalal and Soft stages as they are usually picked and consumed as such. The dry cultivars were harvested at dry or Tamar stage and spread outdoor under sunlight for further drying.

The T.S.S. values in Khalal stage are almost half of the values found in both Soft and Dry stages. This is also reflected in the low sugar content as shown in Table 1. The Soft stage showed the highest total sugar content followed by the Dry stage. Most of dates sugar is present in the form of reducing types. It was found that glucose and fructose were the dominant forms of inverted sugars in Iraqi dates which are mostly semi-dry (8).

The total sugars during Soft stage ranged from 15.32% in Zaglul cultivar to 26.94% in M.W. Khateeb. Minessy *et al* (5) reported that sugars accumulated gradually during the fruit development and they were mainly in reducing form. The Alcohol Insoluble Solids (A.I.S.) were also found to be very low in Khalal stage as compared to Soft and Dry stages. The higher A.I.S. values were obtained at the Soft stage followed by the Dry stage.

The titrable acidity was in general low in the three stages of maturity. It ranged from 0.096% in Zaglul (Khalal stage) to 0.486% in Madina (Soft stage). It was reported that dates are generally characterized by low acidity (4).

The yellow colour was the predominant colour in all the cultivars pulp in the three stages of maturity except in Madina cultivar during the Khalal stage where the red colour is predominant. From the above results (Table 1) it is evident that Khalal stage is characterized by having low total soluble solids, low alcohol insoluble solids and weak date flavour as compared to Soft and Dry stages. Therefore, Khalal stage could be considered as unsuitable for jam-making compared to Soft and Dry stages. Date-jam has to be manufactured during Soft stage of maturity where the maximum concentration of sugars, high percentage of alcohol insoluble solids and rich flavour are reached.

Table 2 shows the formulas developed during this study taking into consideration the initial chemical composition of the pulp. As could be seen

from table 2 that the amount of sugar and pectin required per one kilogram pulp were far less in the Soft stage than in Khalal stage while the amount of citric acid is far less in Khalal stage than in Soft stage.

Table 3 shows the chemical analysis of the jams produced based on the recipies shown in Table 2. The pH values ranged from 3.2 to 3.4. The titrable acidity ranged from 0.489 to 0.6%. The T.S.S. ranged from 68 to 70% for most of the cultivars. Rauch (7) stated that in order to produce a good quality jam the pH should be within 3.2 to 3.4. Titrable acidity should be between 0.5 to 0.9%. Most of the food laws of the World provide for a minimum percentage of total soluble solids of 68 to 70 % in jam making. The results shown in Table 3 are within the recommended standards of jam-making.

LITERATURE CITED

1. Association of Official Agricultural Chemist (AOAC) (1970): Official and Tentative Methods of Analysis, Washington D.C.
2. Hashim M.O; A. Mubarak; A.A. Hassan; E.A. Omer; I.A. Magid & D.M. Mubarak (1976): Proposed development and operational plans for Karima canning and Date Packing House (Technical Report).
3. Horticultural Dept., Ministry of Agriculture, Food and Natural Resources. Annual report. 1978.
4. Mikki M.S.; W.F. Al Tai and T.S. Jaafer (1978): Studies on date-jams. 1 — Suitability of different commercial date cultivars for jam-making. Palms and Date Research Centre Tech. Bulletin No. 6. (Baghdad).
5. Minessy F.A.; M.A.A. Bacha & T.S. Jaafar (1978): Studies on sugars and nutrient elements content in fruits of four date varieties in Egypt. Alexandaria J. of Agric. Res. 23: 301.
6. Passat, F.F. (1971): The industrialization of date palm products. Al-Adib Printing Press — Baghdad, Iraq.
7. Rauch G.H. (1965): Jam manufacture 2nd edn. Leonard Hill Ltd., London, England.
8. Yossif A.K.; N.D. Benjamin; Mhui elddins & S.M. Ali (1976): Nutritive value of commercial Iraqi date cultivars. 1 — Chemical composition. Palms and Date Research Centre Tech. Bull (Baghdad). 7:37.

Table 1

Effect of stage of maturity of date cultivars on the chemical composition of the pulp

Stage of maturity	pH	Titrable acidity % citric	% Total soluble solids	% Reducing sugars	% Total sugars	% Alcohol insoluble solids	Colour				Date Falvour
							R.	Y.	B.	%Y	
Khalal Stage											
Zaglul	5.4	0.096	8.0	5.25	6.89	0.87	4.0	5.3	3.3	42.0	×
Madina	7.3	0.444	7.0	5.01	6.24	0.86	5.0	4.4	1.2	41.5	×
M.W. Laggai	7.8	0.213	12.0	9.87	11.48	0.98	3.0	3.4	1.2	57.9	×
M.W. Khateeb	7.5	0.426	15.0	13.23	14.10	1.18	3.2	4.3	1.4	38.2	×
Soft Stage											
Zaglul	7.6	0.313	20	11.68	15.32	2.96	6.0	6.3	4.2	38.2	×××
Madina	7.4	0.486	23	13.51	17.56	1.51	4.0	8.2	1.2	61.2	×××
M.W. Laggai	7.4	0.439	22	19.98	20.85	3.50	3.1	6.0	2.1	53.6	×××
M.W. Khateeb	7.3	0.4418	29	22.46	26.94	4.49	6.1	9.3	4.0	47.9	×××
Dry Cultivars											
Tamoda	5.8	0.116	23	15.75	18.48	1.07	3.2	6.0	2.1	53.1	××
Gondaila	5.7	0.140	22	15.75	18.48	1.07	3.2	5.0	2.2	48.5	××
Gaw	6.2	0.128	15	9.60	13.50	1.65	4.2	6.0	2.1	48.8	××
Barakawi	5.4	0.109	14	10.11	13.97	3.85	4.1	6.0	2.1	49.2	××

R. = Red
Y. = Yellow
B. = Blue
X = Weak
XX = detectable
XXX = Strong

Table 2
Date-Jams recipies for each cultivar
at the different stage of maturity

Cultivar and stage of maturity	Pulp kg	Sugar kg	Citric acid g	Pectin (15 – grade) g
Khalal stage				
Zaglul	1.0	1.80	14.0	12.0
Madina	1.0	1.90	9.0	12.0
M.W. Laggai	1.0	1.70	6.5	10.0
M.W. Khateeb	1.0	1.66	10.0	6.0
Soft stage				
Zaglul	1.0	1.50	20.0	10.0
Madina	1.0	1.40	16.0	8.0
M.W. Laggai	1.0	1.44	13.08	7.0
M.W. Khateeb	1.0	1.20	12.0	5.0
Dry cultivars				
Tamoda	1.0	1.40	9.9	15.0
Gondaila	1.0	1.44	8.5	15.0
Gaw	1.0	1.66	11.0	12.0
Barakawi	1.0	1.69	9.01	13.0

Table 3
Chemical analysis of the different Jams produced

Cultivar & stage of maturity	pH	% Titrable acidity	% Total soluble solids	Colour			
				R.	Y.	B.	% Y
Khalal stage							
Zaglul	3.40	0.565	70	7.0	8.5	1.4	50.3
Madina	3.40	0.565	69	4.2	11.5	0.7	70.1
M.W. Khateeb	3.50	0.500	69	7.5	9.4	2.2	49.2
Soft stage							
Zaglul	3.20	0.496	70	8.9	5.3	3.1	30.6
Madina	3.20	0.501	70	8.5	5.4	3.0	31.9
M.W. Laggai	3.40	0.570	69	8.6	8.0	2.1	42.8
M.W. Khateeb	3.50	0.610	70	10.0	9.4	3.4	41.2
Dry cultivars							
Tamoda	3.40	0.562	68	7.3	8.0	2.1	46.0
Gondaila	3.39	0.562	70	6.3	8.2	2.1	49.4
Gaw	3.38	0.562	69	8.3	8.0	2.1	43.5
Barakawi	3.34	0.529	70	9.3	8.2	2.1	41.8

R. = Red
Y. = Yellow
B. = Bleu
X = Weak
XX = detectable
XXX = Strong

Date Palm J3 (1): 327 – 336
Published 1984

THE EFFECT OF HIGH TEMPERATURES ON THE DRIED FRUIT BEETLE *CARPOPHILUS HEMIPTERUS* L., A PEST OF STORED DATES IN IRAQ*

A.F. AL-AZAWI

Plant Protection Department, College of Agriculture (Abu-Ghraib), Baghdad University, Baghdad, Iraq.

H.S. EL-HAIDARI

Plant Protection Research Centre, Abu-Ghraib, Iraq

F.M. AZIZ, A.K. MURAD and H.M. AL-SAUD

Department of Palms and Dates, Agriculture and Water Resources Research Centre, Fudhaliya, Baghdad, Iraq.

ABSTRACT

One day-old eggs; 10-12-day-old larvae; 1-3-day-old pupae; 1-3-day-old adults and one-month-old adults of the dried-fruit beetle *Carpophilus hemipterus* L. were exposed to high lethal temperatures of 40, 45, 50, 55 and 60°C for different periods of time in order to determine the exposure times needed to cause 100% mortality among individuals at each stages. 100% mortality for each of the above temperatures respectively occured after exposure times as follows: eggs, 1080, 240, 25, 10 and 5 min.; larvae, 5760, 240, 35, 17 and 10 min.; pupae, 4320, 210, 30, 20 and 15 min.; 1-3-day-old adults, 7200, 240, 60,15 and 10 min.; one-month-old adults, 9060, 480, 25, 20, and 10 min. The lethal times for 50% and 95% mortality (LT50 and LT95) were obtained for each stage and temperature for comparison.

★ This study was done at the Palms and Dates Department, Agriculture and Water Resources Res. Centre, Sci. Res. Council, Baghdad, Iraq.

تأثير درجات الحرارة العالية على حشرة خنفساء الثمار الجافة (*Carpophilus hemipterus L.*) احدى آفاق التمور المخزونة في العراق

عبدالله فليح العزاوي
كلية الزراعة ـ جامعة بغداد ـ أبو غريب/العراق
حيدر صالح الحيدري
الهيئة العامة للبحوث الزراعية التطبيقية
أبو غريب ـ العراق
فوزية محمد عزيز، أمل خضير مراد وهشام السعود
قسم النخيل والتمور/مركز البحوث الزراعية والموارد المائية،
الفضيلية، بغداد ـ العراق.

الخلاصة

تم تعريض بيض بعمر يوم واحد ويرقات بعمر 10-12 يوماً وعذارى بعمر 1-3 ايام وكاملات بعمر 1-3 أيام وبعمر شهر واحد لحشرة خنفساء الثمار الجافة *Carpophilus hemipterus L.* لدرجات حرارة عالية 40، 45، 50، 55 و60 °م لفترات مختلفة لتحديد الوقت اللازم لقتل 100% بين أفراد كل طور منها تحت الدرجات المبينة أعلاه. اظهرت النتائج أن 100% نسبة قتل لكل من درجات الحرارة اعلاه حصلت بعد فترات زمنية من التعريض كالاتي: البيض 1080، 240، 25، 10 و5 دقيقة. اليرقات 5760، 240، 35، 17 و10 دقيقة. العذارى 4320، 210، 30، 20 و15 دقيقة. الكاملات بعمر 1-3 أيام، 7200، 240، 60، 15 و10 دقيقة والكاملات بعمر شهر، 9060، 480، 25، 20 و10 دقيقة. كما تم الحصول من هذه النتائج على أطوال الاوقات اللازمة لقتل 50% و95% (LT50 وLT95) لكل طور وتحت كل درجة حرارة.

INTRODUCTION

The dry-fruit beetle *Carpophilus hemipterus* L. is one of the pests attacking stored dates in Iraq. It feeds on dates of high moisture content and appears on dates that have been in storage for a long time (10).

In Iraq, pests of stored dates are commonly controlled by spraying storehouses with insecticides and fumigating dates. Some undesirable effects, however, are associated with the use of chemical insecticides. Among those are the development of resistance to insecticides, and the undesirable insectcides residues on food (5, 11, 12, 15).

Several alternative methods to chemical control of insects on stored food have been tried. Heat has been tested or used to control insects of stored grain (2, 7, 8, 9, 14) especially *Ephestia cautella* and *Oryzaephilus surinamensis,* of stored dates (2, 10). Heat combined with vacuum was also tested against *E. cautella* (3). This paper reports the effect of heat on another insect pest of stored dates; *C. hemipterus* as a part of a project aiming at replacing chemical control of insects of stored dates with other methods.

MATERIALS AND METHODS

1. *Insect culture:*

A culture of *C. hemipterus* was maintained inside petri-dishes that were kept within an incubator with constant temperature of 30°C and 55% RH. An egg laying petri-dish size 9cm was supplied with 16g nutritive medium of date and yeast, and an egg laying site with five pairs of *C. hemipterus*.

The nutritive medium as thick paste was prepared by mixing 200g of ground dry dates of zehdi varieyt with 10% yeast, and was smeared on the inside rim of the petri-dish.

An egg laying site was made from two squared cover glasses, 2.5 × 2.5cm facing each other and separated by two pieces of cardboard, 1 × 1cm, and a water moistened filter paper as large as the cover glass placed in-between the cardboard pieces. The cover glasses were fastened with a rubber band.

Eggs were laid on the filter paper. Every 24 hours, the eggs were removed to be used for treatment, or rearing larvae, pupae or adults of known ages for treatment. Rearing of these stages was done in petri-dishes size 5cm, and each was supplied with 6g of the nutritive medium (modified method of Vincent and Lindgreen (16).

2. *Treatment:*

Ten to twenty, 1-day-old eggs, 10-12 day-old larvae, 1-3-day-old pupae, 1-3-day-old adults or 30-day-old adults were placed in 6cm petri-dishes containing 4g of food medium, representing one replicate out of 3-5 replicates per treatment. A treatment consisted of exposing any of these stages for varioustimes to 40, 50, 55 or 60°C temperature in order to obtain upto 100% mortalities. For each treatment, a control was prepared of the same number of insects and replicates and these were kept under 30°C. After the exposure to lethal temperatures, the petri-dishes were transferred to 30°C and left there for different lengths of time before being examined to record the number of dead and alive insects. Eggs were examined two days later, larvae and adults one day later, and pupae were examined every day until adults emerged. Mortalities were calculated according to Abbott's Formula (1)

Average mortalities for each temperature was plotted against exposure times on logarithmic probability graph paper. A linear graph was fitted to obtain estimates of the lethal times for 50 or 95% mortalities of the population expressed as Lt 50% or Lt 95%. (2, 13 and 9)

Movement of temperature from the sides to the centre of date mass were also investigated in both oven and sun.

RESULTS AND DISCUSSION

Table 1 shows the estimated LT50 and LT95 for each stage of *C. hemipterus* at 40 – 60°C. Data in the table reveal that: –

1 – Different stages of *C. hemipterus* responded differently to hgih lethal temperatures. For example, at 40 and 45°C adults show more resistance while the eggs are least resistant to these temperatures. At 40°C, the LT50 for 1-3 day and 30 day old adults are six and elevent times longer than the

LT50 for the eggs. Even the adults age responds differently to temepratures. The 30-day old adults are more resistant than the 1-3-day old adults. At 40°C, the LT50 for the older adults is nearly twice as much as that of the younger ones.

2 – Resistance decreases as temperature increases. Accordingly, four temperature responses are detected: 40, 45, 50 and 55-60°C. In general, the LT50 or LT95 at 40°C is several times longer than at 45°C and this is several times longer than at 50°C. On the other hand the LT50 or LT95 at 50°C is nearly double than that of 55°C or two to several times than that at 60°C.

3 – With the increase in temperature, the LT50 comes closer to LT 95. The difference between them does not exceed 3 minutes.

The aforementioned conclusions are also observed in data of Table 2 which shows the actual LT100 for each stage of *C. hemipterus* at 40 to 60°C.

Temperature is an important factor affecting insect life and activity. When the temperature changes beyond the species tolerance, the insect activity slows down and eventually dies. For most insects, the upper lethal temperature for a short exposure is between 40-50°C (4)

Death is attributed to various factors. Among these are the proteins being denatured, the disturbance of metabolic processes, exhaustion of food reserve and desication (6, 17).

While data in Table 1 are useful for comparing the responses of each stage of *C. hemipterus* to lethal temperatures, data in Table 2 may be practically useful for controlling insect pests of stored dates by temperature treatment.

Theortically speaking, *C. hemipterus* could be controlled if the temperature of dates in the centre of a date mass in a package, boxes or either is raised to any of the lethal temperatures selected from Table 2 and maintained to a minimum length of time that would cause 100% mortality of all of the insect stages. For example, if 40°C is chosen to treat dates infested with *C. hemipterus,* then the centre of such date mass should be raised to

40°C and kept at 40°C for a minimum at 9060 minutes. When 45, 50, 55 or 60°C are considered, then the minimum exosure time should be 480, 60, 20 or 15 minutes, respectively.

To study heat movement in a mass of dates two simple tests were made. In the first one a 20 × 20 × 18cm. metal basket filled with 4kg. dry Zahdi dates was placed in a 55-60°C oven. The temperature in the centre of the date mass was raised from 35 to 45°C within four hours.

In a second experiment, two plastic boxes, the types used for transporting and storing dates, were used. Each box measured 39.5 × 30.5 × 20cm. and was filled with 14kg. dried Zahdi dates. One was placed in an oven whose temperature was adjusted to 60°C while the other one was kept in the sun on the laboratory roof. Table 3 shows the temperature rise in these two boxes. Within ten hours, the temperature of the date mass centre in the first box was raised to 50°C while that of the centre of the sides to 58°C. On theother hand, the temperature of the date mass centre of the box that was kept on the roof was raised from a minimum temperature of 34°C to a maximum of 40°C at noon five hours later, and dropped to 37°C at approximately four p.m.

Further tests are needed to learn more about heat treatment for insect control in a large date mass. In such experiments, several factors should be considered. Among these are the size of the mass, the type and size of the date containers, their arrangement and spaces between them, source and type of heating elements, air movement within the treating area and date moisture. In addition, the economic feasibility and practicality of such method ought to be considered as well.

The use of solar energy for disinfesting dates from insect might also be considered. Such method is possible if the solar heat is trapped and kept throughout the night with some heat supplement to keep the lethal temperature of the treated dates at the minimum.

When the high lethal temperature for the major insect pests of stored dates are determined as have been reported here, it would be possible to choose the right temperature that would cause death to all date insects at

the same time and proves economical and causes improvement of date quality.

The use of heat to improve the quality of date has already been reported (13). Therefore, this method of treatment serves a double purpose, insect control and improvement of date quality.

LITERATURE CITED

1. Abbott, W.S. (1925): A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18:265-267.
2. Al-Azawi, A.F.; H.S. El-Haidari; F.M. Aziz & A.K. Murad (1983). Effect of high temperatures on fig moth *Ephestia Cautella* Walker (Lepidopera: Pyralidae) in Iraq. Date Palm J., 2: 79-85.
3. Al-Azawi, A.F.; H.S. El-Haidari; H.M. Al-Saud & F.M. Aziz (1983): Effect of reduced atmospheric pressure with different temperatures on *Ephestia cautella* Walker (Lepidoptera, Pyralidae), a pest of stored dates in Iraq. Date Palm J., 2(2): 223-233.
4. Bursell, E. (1974): Environmental aspects-temperature in the physiology of insects vol. 2, ed by R. Morris, Academic Press Ltd., London, England.
5. Champ, B.R. & C.E. Dyte (1976): Report of the FAO global survey of pesticides on susceptibility of stored grains pests. FAO Plant Protection Bull., 25: 49-67.
6. Chapman, R.F. (1975): The insects structure and function, The English Univ. Press Ltd., London, England.
7. Cotton, F.R. (1960): Pests of stored grain products, Burges Publishing Co., Mineapolis, Minn., U.S.A.
8. Dermott, T. & D.E. Evans (1978): An evaluation of fluidized – bed heating as a means of disinfecting wheat. J. Stored Prod. Res., 14: 1-12.
9. Evans, D.E. & T. Dermott (1981): Dosage mortality relationships for *Rhizopertha dominica* (F.) (Coleoptera: Bostrichidae exposed th heat in a fluidized bed., J. Stored Prod. Res., 17: 53-64.
10. Hussain, A.A. (1974): Date palms and dates with their pests in Iraq. Univ. of Baghdad. pp. 190.
11. Lindgren, D.L. & L.E. Vincent (1966): Development of resistance in stored products insects to insecticides. Cereal Sci. Today 26: 11-14. (Quoted by Ali Niazee, M.T., J. Stored Prod. Res., 1971, 7: 243-252).
12. Lindgren, D.L. *et al* (1968): Residues in raw and Processed foods resulting from post-harvest insecticidal treatments. Residue Rev. 21: 1-128. (Quoted by Ali Niazee, M.T., J. Stored Prod. Res., 1971, 7: 243-252).
13. Maier, V.P.; D.M. Metzer & A.F. Huber (1964): Effects of heat processing on the properties of dates. Date Growers' Institute Ann. Rept., 41: 8-9.
14. Munro, J.W. (1966): Pests of stored products, Hutchinson and Co., London, England.
15. Pasalu, I.C. *et al* (1974): Status of insecticide resistance in insect pests of stored products, Part 1, Bull. Grain Technology., 12: 50-59.
16. Vincent. L.E. & D.L. Lindgren (1971): Fumigation of dried fruit insects with hydrogen phosphide and ethyl formate. Date Growers' Institute Ann Rept; 48: 4-5.
17. Wigglesworth, V.B. (1953): The principles of insect physiology. Methuen and Co. Ltd., London, England.

Table 1

Lethal time (LT) in minutes estimated, for 50 and 95% mortality of different stages of *C. hemipterus* exposed to 40-60°C for different periods of time.

Stage	40°C		45°C		50°C		55°C		60°C	
	LT50	LT95	LT50	LT95	LT50	LT95	LT50	LT95	LT50	LT95
Egg	540	780	150	180	12	16	5	7	3	4
Larva	2880	3960	180	204	27	30	14	15	7	8
Pupa	1500	2400	150	174	21	25	13	16	10	12
Adutl(1)	3360	5760	162	192	31	42	9	11	7	8
Adutl(2)	6060	6780	186	282	19	22	12	15	7	8

(1): 1-3 days old
(2): 30 days old

Table 2

Lethal times in minutes for actual 100% mortalities of different stages of *C. hemipterus* exposed to 40 – 60°C

	Temp.° C				
Stage	40	45	50	55	60
Egg	1080	240	25	10	5
Larva	5760	240	35	17	10
Pupa	4320	210	30	20	15
Adutl(1)	7200	240	60	15	10
Adult(2)	9060	480	25	20	10

(1): 1-3 days old
(2): 30 days old

Table 3

Temperature rise in 14kg. Zehdi date (dry date) inside plastic containers.

	Oven		Sun		
	Temperature C				
Hour	Centre	Side(1)	Shade	Centre	Side(1)
0	34	34	34	34	34
1	35	36	37	37	36
2	38	40	39	37	37
3	40	43	39	39	38
4	41	44	39	39	39
5	43	46	39	40	40
6	46	49	40	40	40
7	47	50	39	40	40
8	48	51	37	38	38
9	49	52	24	37	37
10	50	58	—	—	—

(1): Ave. of 2 sides

Date Palm J 3 (1): 337 – 347
Published 1984

WHOLESOMENESS STUDIES WITH A FULL DIET OF IRRADIATED DATES ON THE INSECT *Ephestia cautella* (Walker): III. EFFECTS OF LONG TERM FEEDING.

Z.S.AL-HAKKAK*, S.R.ALI, M.S.H. AHMED and S.K.AL-MALIKY

Nuclear Research Centre, Tuwaitha, Baghdad, Iraq.

ABSTRACT

Our previous studies have shown that low doses (50-100 krad) of gamma radiation (Cobalt-60 source) are enough to kill all developmental stages of insect species that are economically important to date industry in Iraq. However, wholesomeness studies are needed in order to evaluate the safety of irradiated dates for consumption purposes. Therefore, in the present experiments, the fig moth, *Ephestia cautella,* used as a test organism, was reared for 5 generations on a 100% diet of date fruits treated with 100 or 200 krad of gamma radiation. Each generation was checked for: i) development from egg to adult stage, ii) female fecundity, iii) mating frequency and iv) the percentage of egg hatchability were also investigated for all the five generations as indicators for genetical effects. Depending on these parameters, no statistically significant effects have been detected. These results suggest that disinfestation of dry dates with such doses of gamma radiation is a safe method in that it has no accumulative adverse effect on the quality of these fruits when used as a full diet for the fig moth, *Ephestia cautella.*

★ Present Address: SRC, Biological Research Centre, Jadiryia, Baghdad, Iraq.

دراسات حول سلامة التمور المشعة المستعملة كغذاء كامل لحشرة عثة التين *Ephestia Cautella*

3 ـ تأثير التغذية لعدة اجيال .

زهير صادق الحكاك(★) ،صديقة رجب علي، محمد سعيد هاشم، أحمد وصديقة كاطع المالكي

مركز البحوث النووية ـ تويثة ـ بغداد ـ العراق

الخلاصة

في دراساتنا السابقة أوضحنا أن جرعات منخفضة من أشعة غاما المنبعثة من مصدر كوبلت ـ 60 كافية لقتل جميع الاطوار لمختلف أنواع الحشرات ذات الأهمية الاقتصادية في صناعة التمور في العراق . وفي نفس الوقت كان معروفاً لدينا الحاجة الى دراسات متخصصة لتقييم سلامة التمور المشعة للاغراض الاستهلاكية .

لذا فان الدراسة الحالية تبحث في تأثير تربية حشرة عثة التين أفيستيا كوتيلا *E. cautella* كحيوان اختبار ولخمسة اجيال على غذاء متكون من 100% تمور زهدي جافة معاملة أما بجرعة 100 أو 200 كيلوراد من أشعة غاما .

في كل جيل تمت دراسة ما يلي : ـ

1 ـ حياتية النمو من البيضة وحتى طور البالغة .

2 ـ خصوبة الانثى ممثلة بمعدل عدد البيض للانثى الواحدة .

3 ـ معدل عدد التزاوجات للانثى الواحدة .

4 ـ معدل النسبة المئوية لتفقيس البيض كمقياس للتأثير الوراثي .

واستناداً الى هذه المقاييس أوضحت النتائج عدم وجود تأثيرات معنوية

★ العنوان الحالي : مجلس البحث العلمي ـ مركز بحوث علوم الحياة ـ الجادرية ـ بغداد ـ العراق .

احصائياً مشيرة الى امكانية اعتبار طريقة تعقيم التمور الجافة من الحشرات بمثل هاتين الجرعتين من أشعة غاما طريقة سليمة لا تسبب في تراكم التأثيرات الضارة في حشرة الافيستيا نتيجة لتغذيتها لعدة أجيال عليها .

INTRODUCTION

In Iraq, large quantities of dry dates are usally attacked and damaged by several stored-product insect pests during storage, transportation and exportation in spite of several fumigations with methyl bromide (13).

A great deal of research data have already been accumulated concerning the effectiveness of ionizing radiation on the survival and fertility of many insect species. The majority of these results agreed that ionizing radiation might offer efficient solutions to the world-wide problems of disinfestation of different food items (14, 15, 16). Our previous studies have shown that low doses (50-100 krad) gamma radiation are enough to kill all developmental stages of insect species that are economically important to date industry in Iraq (1, 2, 6). However, it has been initially realized that wholesomeness tests should be simultaneously carried out in order to evaluate the safety of disinfested date fruits by gamma radiation for human consumption purposes. In this respect, series of experiments were carried out to determine any radiation-induced changes in the chemical composition of date (9, 10, 12).

In an exploratory studies, dates irradiated with very high doses of gamma radiation were used as a whole diet for two important species of stored-date insects, the saw-toothed grain beetle, *Oryzaephilus surinamensis* and the fig moth, *Ephestia cautella*. The results indicated that such doses (625-5000 krad) of gamma radiation did not produce significant adverse effect on the development of these insects in general (3, 5, 7, 8). It has been demonstrated that radiation doses of such magnitude increase the softness of treated date fruits (7, 8, 12). On the other hand, further experiments have shown that no effect could be detected in the development, fecundity and egg hatchability of *Ephestia cautella* when reared upon a complete diet of date fruits treated with the same range of doses (50-100 krad of gamma radiation) which are recommended to sterilize

stored-product as well as for date disinfestation purposes (7, 8).

The present experiments concern the radiation-induced effects on the development and genetics of *E. Cautella* when reared for several generations on irradiated date fruits exclusively. The results of these experiments are reported here.

MATERIALS AND METHODS

Selected dry date fruits (Zahdi variety) were divided into three groups, and treated with O (control), 100 or 200 krad of gamma radiation, respectively. Irradiation procedure was carried out using a Cobalt-60 source of the type Gammacell-220 at a dose rate of 50 krad per second,approximately . Dates of each group were then placed into five one-litre beakers, 40 fruits in each.

The details of *Ephestia cautella* strain used in the present studies, and the procedures of laboratory rearing and egg collection were recorded elsewhere (4, 7, 8). Immediately after irradiation and same treatment of the date fruits, each beaker was seeded with 400 eggs on a wet filter paper, then all the 15 beakers were tightly sealed and incubated at 25°C and 50-60% relative humidity. The same incubation and examination methods were followed according to reference (7, 8). Furthermore, 20 single pair matings were set up between the eclosed adults of each treatment, and female fecundity, mating frequency and egg hatchability were determined for each cross. The experimental procedures were similarly repeated for 5 generations which have been continuously raised on irradiated dates, using the eggs obtained from the succeeding generations of the eggs under study.

RESULTS AND DISCUSSIONS

When comparisons were made between different biological parameters of insects developed on irradiated or unirradiated dates, no statistically significant differences could be found at all generations. Table 1 shows the average percentages of insects reached the stage of last instar larvae out of 400 eggs of *E. cautella* seeded on treated date fruits at each generation. It is clear that, through the 5 generations studied, irradiation of dates with 100 or 200 krad of gamma radiation did not produce any significant differences in the numbers of last instar larvae developed when compared with those developed on the untreated control dates. Similar results have been obtained when the average percentages of insects that reached the

pupal and adult stages were taken into consideration (Tables 2 & 3). The lack of significant differences between the effect of irradiated and unirradiated dates could also be illustrated when the average numbers of spermatophores found per dissected female, and the average numbers of eggs laid per female were calculated at each generation for the three groups of treatments, as demonstrated in Tables 4 and 5. The most important result obtained from the present study is that no statistically significant differences could be detected, in the frequency of dominant lethal mutation induced as a consequences of feeding on a whole diet of irradiated dates for 5 generations (Table 6). This genetical parameter was measured by calculating the average percentages of hatchability of eggs produced from the crosses made between the adults developed on irradiated or unirradiated date fruits.

Thus, the overall results, clearly point out that feeding the fig moth *E. cautella* for 5 successive generations on 100% dry date fruits irradiated with 100 or 200 krad of gamma radiation did not show any indication of unfavourable effects on its developmental and genetical parameters. These results are in a good agreement with the results of several other long term feeding studies of various irradiated foods on different insect species (11, 14). It is expected that the results reported here are of important value and might contribute some information regarding the wholesomeness of irradiated dates, which is a major issue in the safety of using gamma radiation as a clean method for insect disinfestation of dry dates in Iraq. In fact, these data were presented as part of a complete report to be reviewed with several other chemical and toxicological studies by the Joint FAO/AEA/WHO Expert Committee in its Geneva meeting in 1980 to assess the safety of irradiated food. Accordingly, unconditional acceptance was granted for date irradiation for the purpose of controlling infestation with stored-product insects using an average dose of up to 1 KGy i.e. 100 krad (18).

ACKNOWLEDGEMENTS

We thank Mr. A.A. Kadhum for his general assistance, and Mr. H.J. Mohammed for his technical assistance. We also acknowledge the assistance of all the technicians of the Entomological unit of the Nuclear Research Centre for their assistance during the course of this study.

LITERATURE CITED

1. Ahmed, M.S.H. (1975): Investigations on insect disinfestation of dried dates by using gamma radiation, *Presented at* the Joint FAO/IAEA Advisory Group Meeting on Low-Dose Irradiation of Agricultural Products, Rio de Janeiro, Brazil. Date Palm J (1981): 1 (1): 107-116.
2. Ahmed, M.S.H., N.A. Ouda, S.B. Lamooza, Z.S. Al-Hakkak, & A.M. Al-Saqur (1972): Disinfestation of dry dates by gamma radiation, (Proc. First Sci. Conf.) Sci. Res. Found., Baghdad: 264-271.
3. Ahmed, M.S.H.; A.M. Al-Saqur; Z.S. Al-Hakkak & J. Farkas (1973): The effect of irradiated dates on the development of the fig moth, *E. cautella* (Walker) (Lepidoptera, Pyralidae), Unpublished report.
4. Ahmed, M.S.H.; S.B. Lamooza, N.A. Ouda, & I.A. Al Hassany (1975): Preliminary report on mating studies of three varieties of *Cadra (Ephestia) cautella Walker, "Sterility Principle For Insect Control", (Proc. Symp. Innsbruck, 1974) IAEA, Vienna.*
5. *Ahmed, M.S.H.; S.B. Lamooza; N.A. Ouda & J. Farkas (1977): The effect of irradiated dates on the development of Oryzaephilus surinamensis* (L.), Coleoptera, Cucujidae, Acta Alimentaria 6: 187-192.
6. Ahmed, M.S.H.; Z.S. Al-Hakkak, S.K. Al-Maliky; A.A. Kadhum & S.B. Lamooza (1981): "Irradiation disinfestation of dry dates and the possibility of using combination treatment". Combination Processes in Food Irradiation, (Proc. Symp. Colombo, Sri Lanka, 1980) IAEA: 217-228.
7. Al-Hakkak, Z.S.; S.R. Ali; M.S.H. Ahmed & S.K. Al-Maliky (1983): Wholesomeness studies with a full diet of irradiated dates in the insect *E. Cautella,* I. Disinfestation doses of gamma radiation, Date Palm J. 2:87-102.
8. Al-Hakkak, Z.S.; S.R. Ali; M.S.H. Ahmed; & S.K. Al-Maliky 1983:Wholesomeness studies with a full diet of irradiated dates in the insect *E.cautella,* III. Effect of high doses of gamma radiation Date Palm J.2 (2): 235-251.
9. Auda, H.; J. Mirjan; H. Al-Wandawi; F. Al-Charchafchy (1973): Chemical changes induced by radiation in Iraqi dates, "Radiat. Preserv. of Food" (Proc. Symp. Bombay, 1972) IAEA, Vienna: 21.
10. Auda, H.Z. Khalaf, & J. Mirjan (1978): Effect of gamma radiation on the sugar and protein composition of Iraqi dates, "Food Preserv. by Irradiat". (Proc. Symp. Wageningen, 1977) IAEA, Vienna, Vol. 1:459.
11. Brower, J.H. & E.W. Tilton (1973): Development and fecundity of the Ind. Meal moth *Plodia interpunctella* reared on diet orf irradiated nutmeats, Inter. J.Appl. Radiat. Isotopes 24: 327-331.
12. Farkas, J.; F. Al-Charchafchy; M.A. Al-Shaikhaly; J. Mirjan; & H.Auda (1974): Irradiation of dates, Acta Alimentaria, 3: 151-180.

13. Hussain, A.A. (1974) : Date Palms and Dates with their Pests in Iraq . University of Baghdad Press, Baghdad, Iraq.
14. Tilton, E.W. & J.H. Brower (1973): Status of U.S. Department of Agriculture research on irradiation preservation of food, "Radiation Preservation of Food", (Proc. Symp. Bombay, 1972), IAEA, Vienna: 295.
15. Tilton, E.W. & J.H. Browers (1982): Action of radiation on arthropods, In Preservation of Food by Ionizing Radiation, E.S. Josephson and M.S. Peterson (Eds). In Press.
16. Tilton, E.W. & A.K. Burditt (1982): Insect disinfestation of grain and fruits, *In* Preservation of Food by Ionizing Radiation, E.S. Josephson and M.S. Peterson (Eds.), In Press.
17. Tilton, E.W.; J.H. Brower & R.R. Cogburn (1973): Progony production by *Sitophilus coryzae* and *Tribolium castaneum* reared for several generations on irradiated dates, J. Georgia Entomol. Society, 8: 168.
18. WHO, (1981): Wholesomeness of Irradiated Food, Technical Report Series No. 659. World Health Organization, Geneva.

Table 1

Average percentage of larvae produced from 400 eggs of *Ephestia cautella* reared for 5 generations on (Zahdi cv.) dates irradiated with different doses of gamma radiation (5 replicates for each dose per each generation)

Genrations Generations	Control ± S.D*	100 krad ± S.D.*	200 krad ± S.D.*
Parents	32.30 ± 4.05	30.95 ± 3.76	32.15 ± 2.32
First generation	34.05 ± 5.22	33.85 ± 6.02	32.70 ± 6.25
Second generation	32.95 ± 4.38	32.75 ± 5.52	34.00 ± 5.84
Third generation	28.50 ± 4.98	26.40 ± 4.89	26.70 ± 5.33
Fourth generation	32.40 ± 3.66	30.90 ± 4.55	31.78 ± 3.44

★ Averages of the same row are not significantly different at $P > 0.05$.

Table 2.

Average percentage of pupae produced from 400 eggs of *Ephestia cautella* reared for 5 generations on (Zahdi cv.) dates irradiated with two different doses of gamma radiation (5 replicates for each dose per each generation).

Generations	Control ± S.D.*	100 Krad ± S.D.*	200 krad ± S.D.*
Parents	24.80 ± 4.05	23.45 ± 3.76	24.65 ± 2.32
First generation	26.85 ± 2.58	26.15 ± 6.76	27.55 ± 5.84
Second generation	26.30 ± 3.30	26.20 ± 3.50	27.45 ± 4.50
Third generation	24.10 ± 1.94	23.15 ± 2.33	22.70 ± 2.29
Fourth generation	25.48 ± 2.97	24.90 ± 4.09	23.80 ± 2.98

★ Averages of the same row are not significantly different at $P > 0.05$

Table 3.

Average percentage of adults produced from 400 eggs of *Ephestia cautella* reared for 5 generations on (Zahdi cv.)dates irradiated with two different doses of gamma radiation (5 replicates for each dose per each generation).

Generations	Control ± S.D.*	100 Krad ± S.D.*	200 krad ± S.D.*
Parents	21.60 ± 4.31	22.35 ± 3.89	22.20 ± 2.34
First generation	22.15 ± 2.27	21.85 ± 5.40	22.90 ± 4.38
Second generation	21.76 ± 2.23	22.45 ± 4.24	22.95 ± 3.68
Third generation	19.50 ± 2.04	19.40 ± 1.18	18.40 ± 3.01
Fourth generation	20.80 ± 2.91	21.80 ± 3.48	21.90 ± 3.21

★ Averages of the same row are not significantly different at $P > 0.05$

Table 4.

Average numbers of spermatophores per female from crosses of adults produced from 400 eggs of *Ephestia cautella* reared on (Zahdi cv.) dates irradiated with two different doses of gamma radiation (20 dissected females for each dose per each generation)*.

Generations	Control ± S.D.**	100 Krad ± S.D.**	200 krad ± S.D.**
Parents	1.30 ± 0.47	1.40 ± 0.68	1.35 ± 0.41
First generation	1.50 ± 0.69	1.45 ± 0.60	1.35 ± 0.57
Second generation	1.55 ± 0.61	1.45 ± 0.69	1.40 ± 0.59
Third generation	1.35 ± 0.99	1.30 ± 0.55	1.45 ± 0.57
Fourth generation	1.25 ± 0.46	1.20 ± 0.47	1.30 ± 0.58

★ Average number of spermatophores per female for 30 pairs of *E. cautella* adults reared on laboratory medium was 1.10 ± 0.31.

★★ Averages of the same row are not significantly different at $P > 0.05$

Table 5

Average numbers of eggs per female from crosses of adults produced from 400 eggs of *Ephestia cautella* reared on (Zahdi cv.) dates irradiated with two different doses of gamma radiation (20 pairs for each dose per each generation).*

Generations	Control ± S.D.**	100 krad ± S.D.**	200 krad ± S.D.**
Parents	237.65 ± 63.40	226.85 ± 62.71	220.40 ± 88.69
First generation	253.60 ± 68.82	250.35 ± 82.94	249.65 ± 64.72
Second generation	290.30 ± 65.30	305.95 ± 76.76	280.90 ± 105.35
Third generation	298.95 ± 55.15	309.36 ± 72.79	312.73 ± 91.35
Fourth generation	258.25 ± 79.30	265.25 ± 89.76	272.05 ± 89.35

★ Average number of eggs per female for 30 pairs of adults *E. cautella* reared on laboratory medium was 357.23 ± 77.80.

★★ Averages of the same row are not significantly different at $P > 0.05$

Table 6

Average percentage of egg hatchability from crosses of adults produced from 400 eggs of *Ephestia cautella* reared on zahdi dates irradiated with two different doses of gamma radiation. (20 pairs for each dose per each generation).*

Generations	Control ± S.D.**	100 krad ± S.D.**	200 krad ± S.D.**
Parents	80.28 ± 14.34	79.29 ± 15.33	80.68 ± 15.17
First generation	81.90 ± 6.49	83.11 ± 14.91	78.97 ± 15.64
Second generation	86.49 ± 6.69	89.41 ± 9.80	87.84 ± 9.19
Third generation	82.79 ± 8.76	82.34 ± 13.06	84.45 ± 9.39
Fourth generation	85.55 ± 11.22	86.59 ± 18.33	82.22 ± 12.43

★ Average percentage of egg hatchability for 30 pairs of *E. cautella* adults reared on laboratory medium was 84.26 ± 7.90.

★★ Averages of the same row are not significantly different at $P > 0.05$.

Date Palm J 3 (1): 348
Published 1984

SHORT COMMUNICATION
EXPERIMENTAL ESTABLISHMENT OF FIVE DATE PALM CULTIVARS IN SOURTHERN FLORDIA

F.W. Howard, R. Atilano and D. Williams
University of Florida Agricultural Research Center
3205 College Ave., Ft. Lauderdale, FL 33314, USA

A trial garden was planted in southern Florida to evaluate the adaptability and response to insect pests and diseases of 5 cultivars of the date palm, *Phoenix dactylifera* L. Most of the 'Thoory' and 'Medjool' offshoots failed, to generate roots and died during the first year after planting. The 'Zahidi', 'Deglet Noor', and 'Thoory' cultivars were shown to be susceptible to lethal yellowing (LY) disease. The susceptibilities of other cultivars remain unknown. 'Halawy' was the least susceptible of 3 cultivars compared as hosts of graphiola leaf spot fungus, *Graphiola phoenicis* (Maug.) Poit. A cupric hydroxide $Cu(OH)_2$, formulation sprayed biweekly on the leaves was effective in preventing this disease. A planthopper, *Myndus crudus,* implicated as a vector of LY disease, was trapped more frequently in nearby coconut palms. *Cocos nucifera* L., than from the date palms. The date palms were virtually free of other insect pests. The importance of preventing the introduction of LY into date producing regions is stressed.

Date Palm J 3 (1): 349—358
Published 1984

DOCUMENTATION

ABSTRACTS OF RECENT RESEARCH ON THE DATE PALM

S. MOHAN
FAO Regional Project for Palm & Dates Research
Centre in the Near East & North Africa, Baghdad, Iraq.

HAURY, A. Trial on the behaviour of the date palm in Niger: Bonkoukou, Dallol Bosso. Fruits (France) 1982, 37 (10): 727-33, 659-62. (Fr with De, En, Es, Fr. Ru summ) Institut de Recherches sur les Fruits et Agrumes (IRFA), Noumea, New Caledonia.

An Experiment on the forming of an oasis by an upper layer of date palms and a lower layer of citrus, mango and guava is described. Observations on the growth of date palms in the period 1975 to 1980 and the characteristics of their production are presented.

DE MASON, D.A., SEXTON, R. AND GRANT REID, J.S. Structure, composition and physiological state of the endosperm of *Phoenix dactylifera* L. Ann Botany 1983, 52: 71-80.

The date endosperm consists of living cells with the same general cellular structure throughout the seed. The major storage products, as shown by histochemical staining, are lipid, stored as numerous small lipid bodies which fill the cytoplasm, and protein, as large but variably-sized protein bodies. Nuclei are present but lack large amounts of heterochromatin. Plastids and mitochondria are present but infrequently seen and have poorly developed internal membranes. No endoplasmic reticulum or dictyosomes are present before or after hydration .The cell wall is thick except in areas of pit fields and consits of three layers which differ in their staining behaviour: middle lamella, thickened wall and inner wall. Both the

endosperm and embryo of the imbibed seed undergo aerobic respiration, but the embryo respires at a more rapid rate than does the endosperm .A small area of the endosperm around the distal pole of the cotyledon shows histochemically detectable levels of succinic dehydrogenase.

BADAWY, M.F. & AL ABDEL, H.R. Studies on inflorescences rot disease of palm and its control in Sinai peninsula. Research Bulletin. Faculty of Agriculture, Ain Shams University (Egypt). May 1982, No. 1819, 12 p. (Ar & En, 13 ref.) Plant Production Dept., Egyptian Desert Inst., Cairo, Egypt.

The fungus Mauginiella scaette was isolated from date palm inflorescences showing rot disease symptoms. Pathogenicity tests showed that both male and female inflorescences were highly susceptible to the disease. A frequency distribution study covering 13 localities showed that the fungus was present in all localities with percentage ranging from 6 to 39. Chemical control using 14 fungicides 4 days before or after artificial infection showed the best results with Coprachem and Oxychloride (each at 50%) when applied before infection.

DE MONTAIGNE, M. and FALL, A.M. Biological control of date palm scale in Mauritania. Lutte Biologique centre les Ravageurs et ses Possibilités en Afrique de l'Ouest. Compte rendu du séminaire, fév. Dakar (Sénégal) USAID 1981, 191-209 (En & Fr, 17 ref.) Laboratoire d'Entomologie. Nouakchott, Mauritania.

Various predators of the date palm scale, *Parlatoria blanchardi,* are discussed in connection with possible biological control programmes. The most effective species is at the present *Chilocorus bipustulatus* var. iranensis, a ladybird bettle.

MAIGUIZO, M. Summary report on biological control of the white date palm scale *(Parlatoria blanchardi)* in Niger. Lutte Biologique contre les Ravageurs et ses Possibilités en Afrique de l'Ouest. Compte rendu du séminaire, fév. Dakar (Sénégal) USAID, 1981, 205-229 (En & Fr) Institut National de Recherches Agronomiques de Niger, Agadez, Niger.

The introduction of *Chilocorus bipustulatus* var. iranensis for the control of the white date palm scale. *Parlatoria blanchardi,* has been very

successful .The host-predator equilibrium seems to be stable and in some palm tree plantations the balance has been maintained for eight years.

TOURNEUR, J.C. (Homeostasis of modern agro-ecosystems and integrated control.) Annals of the Entomological Society of Quebec 1983, 28 (1): 51-54 (Fr, 7 ref.) Department of Biological Sciences, University of Quebec at Monteral, CP 8888, Monteral H3C 3P8 Canada.

The examples discussed in this review of homeostasis in modern agro-ecosystems in relation to intergrated control include biological control of *Parlatoria blanchardii* (targ.) on date palm in Africa using the predacious coccinellid *Chilocorus bipustulatus* var. *iranensis* Iperti, Laudeho, Brun & de Janvry.

A GLANCE AT THE PAPERS PRESENTED AT THE FIRST SYMPOSIUM ON THE DATE PALM HELD IN SAUDI ARABIA

Following is the classified list of papers presented at the First Symposium on the Date Palm held at the King Faisal University, Al-Hassa, P.O.Box 380, Saudi Arabia, March 23-25, 1982. Abstracts of these papers are included in a publication 'Abstracts on the Date Palm', 1979-1983, compiled by the Project.

General

1. Al-Shinnawy,J.A. A look at the Plantation of Date Palm in the Oasis of Al-Hassa (In Arabic). 726-736.
2. Brown, G.K. Date Production Mechanization in the U.S.A. 2-15.
3. Elprince, A.M., M. Makki, S. Al-Barrak and M.Tamim. Use of Computer Graphics in Developing Density Maps for the Date Culture of Al-Hassa Oasis in Saudi Arabia. 674-683.
4. Gorchels, C. Bibliographic Control of Current Research on Date Palm. 738-741.

Climate

5. Al-Sharafa, M.Y. Study of the Climatic Conditions and Geogra-

phical Distribution of Date Production Regions in Libya (In Arabic). 664-672.

Cultivation

6. Asif, M.I., O.A. Al-Tahir and M.S. Al-Kahtani. Inter-Regional and Inter-Cultivar Variations in Date Grown in the Kingdom of Saudi Arabia. 234-248.
7. Curran, P., and N. Adawy. Landsat MSS Data, Its Availability and Suitability for Monitoring the Density of Date Palms in Saudi Arabia. 684-691.
8. Hamad, A.M., A.I. Mustafa and M.S. Al-Kahtani. Effect of Na-Metabisulfite Alone and In Combination with Na-Benzoate on the Microbial Flora and Quality of Six Soft Date Varieties. 480-495.

Botany

9. Bougeudoura, N. Development and Distribution of Axillary Buds in *Phoenix dactylifera* L. 40-45.
10. DeMason, D.A., R. Sexton and J.S.V. Grant Reid. Structual and Functional Aspects of Date Palm Germination. 26-39.
11. DeMason, D.A., K.W. Stolte and B. Tisserat. Floral Development in *Phoenix dactylifera* L. 46-60.

Varieties

12. Abdulla, K.M., M.A. Meligi and S.Y. Risk. Influence of Crop Load and Leaf/Bunch Ratio on Yield and Fruit Properties of Hayany Dates. 222-232.
13. Meligi, M.A., G.F. Sourial, A.M. Mohsen, A. Kalifa and M.Y. Abdalla. Fruit Quality and General Evaluation of Some Iraqi Date Palm Cultivars Grown Under Conditions of Barrage Region, Egypt. 212-220.
14. Sawaya, W.N., J.K. Khalil, H.A. Khatchadourian, W.M. Safi and A.S. Mashadi. Sugars, Tannins and Some Vitamins Contents of Twenty-Five Date Cultivars Grown in Saud Arabia at the Khalal (Mature Color) and Tamer (Ripe) Stages. 468-478.
15. Sawaya, W.N., W.M. Safi, J.K. Khalil and A.S. Mashadi. Physical

Measurements, Proximate Analyses and Nutrient Elements Content of Twenty-Five Date Cultivars Grown in Saudi Arabia, at the Khalal (Mature Color) and Tamer (Ripe) Stages. 454-467.

16. Sawaya, W.N., W.M. Safi, A. Al-Shalhat, and H.Al-Mohammed. Fruit Growth and Composition of Khudari, Sillaj and Sifri Date Cultivars Grown in Saudi Arabia. 202-209.
17. Sourial, G.F., M.A. Meligi, A.H. Mohsen, A. Khalifa and M.Y. Abdalla. Fruit Setting, Yield and Bunch Characteristics of Some Iraqi Date Palm Cultivars Grown Under Conditions of the Barrage Region, Egypt. 196-201.

Cultural Practices

18. Bacha, M.A. and A.A. Abo-Hassan. Effects of Soil Fertilization on Yield, Fruit Quality and Mineral Content of Khudari Date Palm Variety. 174-180.
19. El-Hamady, M.M., A.S. Khalifa, and A.M. El-Hammady. Fruit Thinning in Date Palms with Ethephon. 284-295.
20. Hussein, F. and M.A. Hussein. Effect of Nitrogen Fertilization on Growth, Yield and Fruit Quality of Sakkoti Dates Grown in Asswan. 182-189.
21. Hussein, F. and M.A. Hussein. Effect of Irrigation on Growth, Yield and Fruit Quality of Dry Dates Grown in Asswan. 168-173.

Pollen & Pollination

22. Abo-Hassan, A.A., T.A. Nasr and H.A. El-Shuks. Effects of Type and Storage of Pollen on Fruiting of Khudari Dates. 102-106.
23. Al-Tahir, O.A., and M.I. Asif. Study of Variations in Date Pollen Material. 62-66.
24. El-Ghayaty, S.H. Effects of Different Pollinators on Fruit Setting and Some Fruit Properties of Siwi and Amhat Date Varieties. 72-82.
25. Khalil, A.R. and A.M. Al-Shawaan. Evaluation of Simple and Practical Methods for Storing Date Palm Pollen Grains (In Arabic). 120-125.
26. Higazy, M.K., S.H. El-Ghayaty and F.B. El-Makhton. Effects of

Different Pollen Types on Fruit Chemical Properties of Some Date Varieties. 94-101.

27. Higazy, M.K., S.H. El-Ghayaty, and F.B. El-Makhton. Effects of Pollen Type on Fruit Setting, Yield and Some Physical Fruit Properties of Some Date Varieties. 84-93.
28. Hussein, F. Pollination of Date Palm and its Effect on Production and Quality of Fruits. (In Arabic). 16-24.
29. Khalil, A.R. and A.M. Al-Shawaan. Wheat Flour and Sugar Solution Media as Carriers for Date Palm Pollen Grains (In Arabic). 68-71.

Growth Regulators

30. Abd Alaal, A.F., K.K. Al Salih, H. Shabana and G.J. Al-Salihy. Production of Seedless Dates by Application of Growth Regulators. (In Arabic). 276-282.
31. Abou Aziz, A.B., S.S. Maximos, I.A. Desouky and N.R.E. Samra. Effect of GA_3 and Hand Pollination on the Yield and Quality of Siwi Dates. 258-268.
32. Asif, M.I., O.A. Al-Tahir and Y.M. Makki. Effects of Some Growth Chemicals on Fruit Morphological Characteristics of Gur and Khalas Dates. 270-275.

Propagation: Vegetative Propagation

33. Hussein, H.M., and H. El-Haidari. Offshoots as a Problem Facing the Expansion of Date Palm Cultivation. (In Arabic). 694-697.

Propagation: Tissue Culture

34. Ammar, S. and A. Ben Badeis. Vegetative Propagation on Date Palm (*Phoenix dactylifera* L.) by *In Vitro* Culture (In Arabic). 158-166.
35. Beauchesne, G. Vegetative Propagation of Date Palm *(Phoenix dactylifera* L.) by *In Vitro* Culture. 698-700.
36. El-Henawey, H.M., A. El-Din, Z. Bondok, S.A. Habib and A.M. Sabour. Trials on Vegetative Propagation of Date Palm by Means of Tissue Culture (In Arabic). 702-704.
37. Khalil, M.S., M.A. Khan and M.S. Al-Kahtani. *In Vitro* Embryo of

Date Palm *(Phoenix dactylifera* L.) 142-150.

38. Khan, M.A., M.S. Khalil and M.S. Kahtani. *In Vitro* of Different Tissues of Date Palm. *(Phoenix dactylifera* L.) 152-157.
39. Tisserat, B., M.D. Nelson, J.M. Ulrich and B.J. Finkle. Cryostorage Techniques to Preserve Date Palm Germplasm. 108-119.
40. Tisserat, B. Development of New Tissue Culture Technology to Aid in the Cultivation and Crop Improvement of Date Palms. 126-140.

PROCESSING & PRODUCTS

Laboratory Analysis

41. Al-Whaibi, M.H. Mineral Content of Date Palm Seedlings. 190-195.
42. Khatab, A.G.H., A.H. El-Tinay and A.A.M. Nour. The Chemical Composition of Some Date Palm Cultivars Grown in Sudan. 706-710.

Processing

43. Al-Ogeidi, H.K., G.A.H. El-Baradie and M.A. Massih. Use of Dates in Pickle Making – 1. Possibility of Pickling Dates in Kimri Stage. (In Arabic). 748-752.
44. Al-Ogaidi, H.K. and N.A. Al-Khafaji. The Effect of Hydrogen Ion Concentration and Temperature on Biomass Production of *Candida* sp. Using Date Extract. (In Arabic). 738-746.
45. El-Saddi, G.K. & N. Benjamin. Date Technology in Iraq. (In Arabic). 754-756.
46. Gabr, F.S. Present and Future Prospects of Date Processing in Arab World as Discussed in the Minutes of the First Arab Conference on Date Palm and Dates Held in Iraq. (In Arabic). 758-762.
47. Hussein, M.A., M.A.E.F. Abdullah, A.H. Guinena, S.F.A. Megeid and N. El-Emary. Adulteration of Coffee by Similarly Treated Seeds of Dates *(Phoenix dactylifera* L.) 560-563.
48. Mustafa, A.I., A.M. Hamad and M.S. Al-Khatani. Date Varieties for Jam Production. 496-502.
49. Shabana, H.R., & S. Mohammed. Mechanization of Date Production (In Arabic). 712-714.
50. Yousif, A.K., H.K. Hassan, B.T. Saed and M.Y. Elia. Studies on

Khalal Matbuukh – Effect of Khalal Time Picking on the Physical, Chemical and Organoleptic Properties of the Produced Khalal Matbuukh (In Arabic). 582-592.

Products

51. Fres, H. Utilization of Date Palm Leaf Midribs for the Manufacture of Panel Board Products. 564-571.
52. Hamad, A.M., A.I. Mustafa and M.S. Al-Kahtani. Possibility of Utilizing Dates Syrup as a Sweetening and Flavouring Agent in Ice Cream Making. 544-550.
53. Khatchadourian, H.A., W.N. Sawaya, J.K. Khalil, W.M. Safi and A.A. Mashadi. Utilization of Dates *Phoenix dactylifera* L. Grown in the Kingdom of Saudi Arabia in Various Date Products. 504-518.
54 Lambiote, B. Some Aspects of the Role of Dates in Human Nutrition. 572-579.
55. Mikki, M.S., V. Th. Bukhaev, and S.F. Zaki. Production of caramel Color from Date Juice. 552-559.
56. Mikki, M.S., W.F. Al-Tai and Z.S. Hamodi. Industriallization of Dates and Development of New Products 1 – Canning of Date Pulp and Khalal Dates. 520-532.
57. Mustafa, A.I., A.M. Hamad, A.N. Wahdan and M.S. Al-Kahtani. Extraction of Date Syrup (Dibs) and Its Utilization in Bakery Products and Juice. 534-543.

Storage

58. Gillani, A.H. Effect of Curing Agents on the Physical Characters and keeping Quality of Date Fruit. 250-256.

Marketing

59. Ali, G.A. Date Production Cost Comparison in Al-Hassa and Indio. 594-603.
60. Khalifa, A.A. Production and Marketing of Dates-Problems and Means to Overcome them in Saudi Arabia (In Arabic). 639-660.
61. Mohammed, A.M.R. The Economics of Date Palms in the Arab World (In Arabic). 716-724.

62. Sabbri, M.M., Y.M. Makki and A.H. Salehuddin. Study on Dates Consumers Preference in Different Regions of the Kingdom of Saudi Arabia (In Arabic). 618-636.

PLANT PROTECTION

Pathology

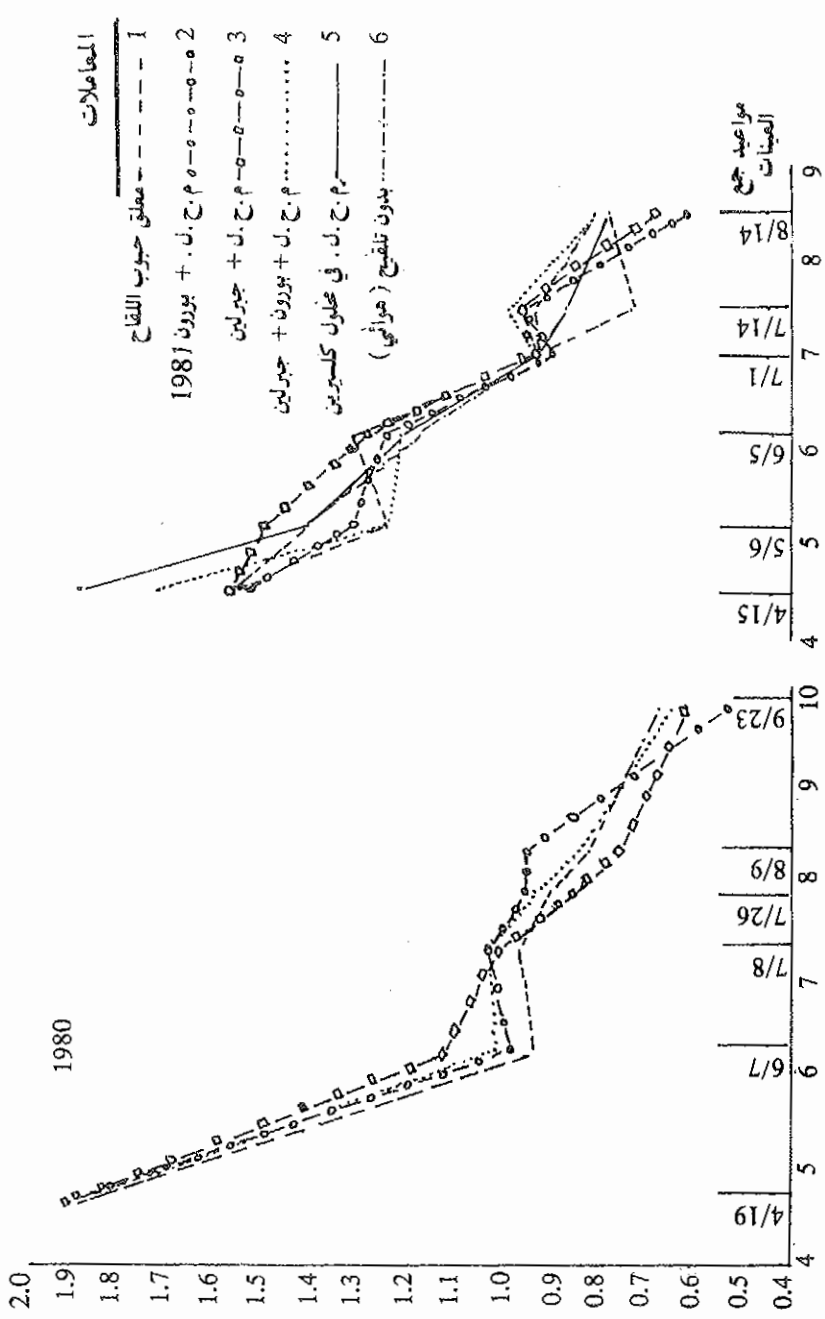
63. Besri, M. Importance of Bayoud Disease *(Fusarium oxysporum* f. sp. Albedenis Malencon) of Date in Morocco. 424-431.
64. Elarosi, H., A.E.A. Mussa and N. Jaheen. Date Fruit Rots in the Eastern Province of Saudi Arabia. 368-380.
65. Elarosi, H., H. El-Said, M.A. Nagieb and N. Jaheen. Al-Wijam, Decline Date Palm Disease. 388-403.
66. Ohr, H.D., T.V. Feather, and D.E. Munnecke. Occurrence and Symptomology of Fusarium Wilt of Canary Island Palms in California. 282-386.
67. Sharif, M., and I, Wajih. Date Palm Pests and Diseases in Pakistan 440-451.

Entomology

68. Abdel Salam, A.L. and A.A. El-Saeady. Ecological Studies on *Ephestia calidella* Walker and *E. cautella* Guen. As Date Insect Pests at Baharia Oases. 314-320.
69. El-Bashir, S. and S. El-Makaleh. Control of the Lesser Date Moth *Batrachedra amydraula* Meyrick in the Tihama Region of the Yemen Arab Republic. 418-422.
70. El-Adeemy, M.S., and R.M. Mobarak. The Use of Sampling and Actual Measurement to Estimate Dates Production in the Kingdom of Saudi Arabia (In Arabic). 604-616.
71. El-Saeady, A.H.A., and A.L. Abdel Salam. Ecological Studies on *Ephestia cautella* Walker. 306-313.
72. El-Sayed, A.H.A., and A.L. Abdel Salam. Ecological Studies on *Ephestia cautella* Walker. 306-313.
72. El-Sayed, S.A. and N.A. Baeshin. Feasibilitv of Disinfestation of

Date Fruits Produced in Saudi Arabia by Gamma Irradiation. 342-350.

73. Hammad, S.M., A.A. Kadous and M.M. Ramadan. Predators and Parasites of Date Palm Insects in Al-Hassa and Al-Qatif Regions (Eastern Province, Saudi Arabia). 322-341.
74. Hammad, S.M., A.A. Kadous, and M.M. Ramadan. Seasonal Abundance of the Scale Insect *Aoinidiella orientalis* (Newstead) On Reziz Variety of Date Palm in Al-Qatif Region, Saudi Arabia. 298-305.
75. Kadous, A.A., S.M. Hammad, and M.M. Ramadan. Assessment of Damage Inflicted Upon Date Palms by *Pseudophilus testaceus* Gahan and *Cryctes elegan* Prell. in Al-Hassa Oasis. 352 361.
76. Matsumura, F. Mechanisms of Action of New Type of Insecticides and their Implication on Management of Agricultural Pests. 404-416.
77. Saleh, M.R.A., and M.M. Hosny. Effect of Destruction of Acacia Pods and the Number of Acacia Trees on the Infestation of Date Fruits by *Virachola livia* Klug. in the New Valley Egypt (In Arabic). 362-367.
78. Talhouk, A.S. The Present Status of Date PALM Pests in Saudi Arabia. 432-438.



شكل رقم (1): يبين النسبة المئوية للبروتين في الأزهار والثمار خلال موسمي التجربة 1980 و1981

جدول (6) : النسبة المئوية للمواد الصلبة الذائبة الكلية في الثمار (T.S.S.)

رقم المعاملة	المعاملة	الموسم الأول 1980	الموسم الثاني 1981		الموسم الثالث 1982	
			مكشوف	مغطى	مكشوف	مغطى
1	معلق حبوب اللقاح	63.46	61.20	62.40	62.40	64.40
2	م . ح . ل . + بورون	62.26	65.30	67.60	68.26	69.60
3	م . ح . ل . + جبريلين	62.66	67.60	68.40	65.44	71.80
4	م . ح . ل . + بورون + جبريلين	63.53	69.40	67.80	69.66	72.20
5	م . ح . ل . في محلول كليسرين	—	64.60	—	63.20	57.40
6	بدون تلقيح (تلقيح هوائي)	—	63.20	—	58.46	—
7	تلقيح يدوي	—	—	—	73.40	75.40
	قيمة أقل فرق معنوي الجديد	غ . م .	غ . م .	غ . م .	غ . م .	غ . م .

جدول (5) : النسبة المئوية للمحتوى الرطوبي للثمار في مرحلة التمر

رقم المعاملة	المعاملة	الموسم الأول 1980	الموسم الثاني 1981		الموسم الثالث 1982	
			مكشوف	مغطى	مكشوف	مغطى
1	معلق حبوب لقاح	22.16	36.30	34.46	35.00	34.00
2	م . ح . ل . + بورون	23.67	15.10	24.53	16.66	21.66
3	م . ح . ل + جبريلن	22.54	23.90	31.43	13.66	22.66
4	م . ح . ل . + بورون + جبريلين	25.18	18.43	27.13	21.00	22.33
5	م . ح . ل . في محلول كليسرين	—	28.33	—	33.00	41.66
6	بدون تلقيح (تلقيح هوائي)	—	30.93	—	31.00	—
7	تلقيح يدوي	—	—	—	15.66	12.00
	قيمة أقل فرق معنوي الجديد	غ . م .	11.24	9.34	غ . م .	28.40

جدول (4) : متوسط وزن الحاصل الكلي بالعذق (كغم)

رقم المعاملة	المعاملة	الموسم الاول 1980	الموسم الثاني 1981		الموسم الثالث 1982	
			مكشوف	مغطى	مكشوف	مغطى
1	معلق حبوب لقاح	2.89	2.52	1.48	1.96	2.43
2	م . ح . ل . + بورون	1.95	2.42	1.71	1.83	2.00
3	م . ح . ل . + جبريلين	2.16	2.70	1.37	2.73	2.60
4	م . ح . ل . + بوبورن + جبريلين	1.38	2.91	1.68	2.40	2.13
5	م . ح . ل . في محلول الكليسيرين	—	1.69	—	1.66	1.73
6	بدون تلقيح (تلقيح هوائي)	—	2.39	—	1.66	—
7	تلقيح يدوي	—	—	—	4.96	6.83
	قيمة أقل فرق معنوي الجديد	غ . م .	غ . م .	غ . م .	1.91	2.75

جدول (3) : النسبة المئوية للثمار العاقدة

رقم المعاملة	المعاملة	الموسم الاول 6/7	الموسم الثاني 6/5		الموسم الثالث 6/30	
			مكشوف	مغطى	مكشوف	مغطى
1	معلق حبوب لقاح	20.10	18.40	9.20	15.00	20.00
2	م . ح . ل . + بورون	21.20	18.20	9.60	15.30	14.00
3	م . ح . ل . + جبريلين	20.00	19.00	9.40	19.30	18.30
4	م . ح . ل . + بورون + جبريلين	19.20	20.00	9.60	18.00	14.60
5	م . ح . ل . في محلول كليسرين	—	14.80	—	10.60	13.30
6	بدون تلقيح (تلقيح هوائي)	—	13.60	—	12.30	—
7	تلقيح يدوي	—	—	—	29.00	31.00
	قيمة أقل فوق معنوي الجديد	غ . م .	غ . م .	غ . م .	غ . م .	7.70

غ . م . = غير معنوي

جدول (2) : النسبة المئوية لحيوية حبوب اللقاح في المحاليل والاوقات المختلفة

رقم المعاملة	الوقت / المعاملة	15 دقيقة	30 دقيقة	60 دقيقة	120 دقيقة	180 دقيقة	المتوسط
1	معلق حبوب لقاح	73.20	46.20	40.00	32.60	30.80	44.56
2	م . ح . ل . ★ + بورون	73.00	58.00	53.20	45.00	42.40	54.32
3	م . ح . ل . + جبريلين	59.40	52.40	47.60	43.60	33.80	47.36
4	م . ح . ل . + بورون + جبريلين	74.80	48.80	44.00	35.20	30.60	46.68
5	م . ح . ل . في محلول كليسرين	85.40	79.00	70.00	62.80	49.60	69.36
6	م . ح . ل . في محلول الكليسرين والسكروز	79.00	70.20	60.60	49.40	44.00	60.64
7	م . ح . ل . في محلول الكليسرين وMBK	76.80	64.40	57.80	49.60	43.60	58.44
8	م . ح . ل . في محلول MBK	76.80	63.20	59.20	51.00	42.60	58.56
	المتوسط	74.80	60.28	54.05	46.15	39.68	

قيمة أقل فرق معنوي الجديد للمعاملات = 14.59

للوقت = 13.84

المعاملات × الوقت = 14.43

★ م . ح . ل . = معلق حبوب لقاح .

جدول(1) : المعاملات المختلفة في المواسم الثلاثة تحت الدراسة

رقم المعاملة	الموسم الأول 1980	الموسم الثاني 1981	الموسم الثالث 1982
1	معلق حبوب اللقاح[1]	معلق حبوب اللقاح	معلق حبوب اللقاح
2	معلق حبوب اللقاح + البورون[2]	معلق حبوب اللقاح + البورون	معلق حبوب اللقاح + البورون
3	معلق حبوب اللقاح + الجبريلين[3]	معلق حبوب اللقاح + الجبريلين	معلق حبوب اللقاح + الجبريلين
4	معلق حبوب اللقاح + البورون + الجبريلين	معلق حبوب اللقاح + البورون + الجبريلين	معلق حبوب اللقاح + البورون + الجبريلين
5	.....	معلق حبوب اللقاح في محلول الكليسيرين[4]	معلق حبوب اللقاح في محلول الكليسيرين
6	.....	بدون تلقيح (تلقيح هوائي)	بدون تلقيح (تلقيح هوائي)
7	.....	.....	تلقيح يدوي

(1) نسبة حبوب اللقاح المستخدمة لكافة المعاملات هي 200 ملغم/لتر .

(2) نسبة البورون كحامض بوريك هي 250 ملغم/لتر .

(3) نسبة الجبريلين كحامض الجبريليك 90% هي 30 ملغم/لتر .

(4) محلول الكليسيرين (50% كليسرين + 50% محلول سكروز 15%) .

11. Ream, C.L. & J.R. Furr (1970): Fruit set of dates as affected by pollen viability and dust or water on stigmas. Date Growers Inst. Rept. 47: 11.
12. Reuther, W. & C.L. Crawford (1946): The effect of temperature and bagging on fruit set of dates. Date Growers' Inst. Rept. 23: 3-7.
13. Shawky, L.; Z. Zidan; A. El-Tomi & D. Dahshan (1978): Effect of GA_3 sprays on time of blooming and flowering malformations in Taimour mango. Egyptian J. Hort. 5(2): 123-132.
14. Snedecor, G.W. & W.G. Cochran (1972): Statistical methods. 6th ed. Iowa State Univ. Press, Ames., Iowa, U.S.A., pp. 593.

المراجع

1 - حسين، فرعون أحمد؛ صالح محسن بدر وسها سلمان العطار (1984). تأثير طرق مختلفة للتلقيح على نوعية وكمية ثمار النخيل. مجلة البحوث الزراعية والموارد المائية. (بحث مقبول للنشر).

2 - خليل، عبدالرحمن وعبدالمحسن الشعوان (1982). استعمال دقيق القمح ومحلول السكروز حاملين لحبوب لقاح النخيل. دليل ندوة النخيل الأولى بالمملكة العربية السعودية المنعقدة بتاريخ 23-25 آذار /1982 ص 68-71.

3 - غالب، حسام علي ونبيل رفيق الشابندر (1983). تأثير فترات التكييس على عقد ووزن وحجم ثمار صنفي الحلاوي والزهدي. المؤتمر العلمي الثالث لمجلس البحث العلمي - بغداد - العراق. 29 تشرين أول - 2 تشرين ثان 1983. بحث رقم 1-3-30 ص 76-77.

4 - كلور، محمود. نمرود بنيامين، حسن رحمن شبانة وطارق العاني (1975). تكون الثمار والبذور في نخيل التمر تحت تأثير طرق مختلفة من التلقيح وبعض منظمات النمو. المؤتمر الدولي الثالث للنخيل والتمور. بغداد 11/30 - 1975/12/4.

5. Arnold, A.J. & H.C. Harries (1979): Hybrid coconut seed production. World Crops. 31 (1): 12-16.

6. Association of official Agricultural Chemists (A.O.A.C.) (1960): Official methods of analysis. 9th ed. Benjamin Franklin Station, Washington, D.C.

7. Fregoni, M.; A. Scienza & R. Miravalle (1978): Studies on the role of boron in the flowering biology and fruiting of grapevine. Rivista della Ortofloro-frutticoltura, Italiana 62(6): 615-622 [HCA. 49(9): 6697.].

8. Furr, J.R. & V.M. Enriquez (1966): Germination of date pollen in culture media. Date Growers' Inst. Rept. 43: 24-27.

9. Mohammed, S.; H.R. Shabana & F.M. Aziz (1978): Investigation on the storage, viability and germination of date pollen of different male cultivars. Palm and Dates research Center Technical Bulletin (Baghdad) No. 1.

10. Pregl, F. (1945): Quantitative inorganic micro-analysis. 4th ed ., J. & A. Churchill, Ltd., London.

للتغطية تأثير ملحوظ . وقد وجد في دراسات اخرى أن التغطية بالاكياس تؤدي الى رفع المحتوى الرطوبي للثمار حتى موعد جني الحاصل (1) .

يعزى ارتفاع المحتوى الرطوبي لثمار بعض المعاملات الى بقاء نسبة كبيرة منها في مرحلة الخلال أو الرطب . أما في معاملة التلقيح اليدوي في المكشوف أو المغطى فتتميز بانخفاض المحتوى الرطوبي للثمار وهذا يعزى الى العقد الجيد نتيجة اتمام عملية التلقيح والاخصاب .

5 ـ النسبة المئوية للمواد الصلبة الذائبة الكلية للثمار:

يتضح من الجدول رقم (6) بأنه لا يوجد تأثير معنوي للمعاملات وفي كافة المواسم على نسبة المواد الصلبة الذائبة الكلية في الثمار بمرحلة التمر، وعلى العموم فان للتغطية تأثيراً طفيفاً على زيادة هذه النسبة في الموسمين الثاني والثالث وان معاملة التلقيح اليدوي تشير الى زيادتها عن باقي المعاملات، كذلك نجدها في الموسم الثاني اذ تكون أقل منها في الموسم الثالث، حيث آن لزيادة كمية المحصول تأثيراً عكسياً على نسبة المواد الصلبة الذائبة الكلية لوجود قابلية محدودة للشجرة لامداد الثمار بالمواد الغذائية (1) . وأيضاً كلما زاد المحصول على الشجرة تقل نسبة السكر فيه (7) .

6 ـ النسبة المئوية للبروتين:

يشير الشكل (1) الى النسبة المئوية للبروتين للموسمين 1980 و1981 ، حيث أنها كانت عالية في مرحلة الازهار والثمار الصغيرة (الحبابوك) وتراوحت (1.87 ـ 1.90 و1.52 ـ 1.87) للموسمين على التوالي عما هي عليه في المراحل التالية لنمو الثمار، حيث كلما تقدمت الثمار في العمر تقل النسبة، اذ تصل الى 0.53 ـ 0.68 في مرحلة الرطب للموسم الاول و0.62 ـ 0.81 في مرحلة الخلال في الموسم الثاني وكان الانخفاض كبيراً في بداية مراحل نمو الثمرة . ولم يكن هنالك تأثيراً واضحاً أو مميزاً للمعاملات في الموسمين الأول والثاني .

هذا الاتجاه وجد في دراسة على نخيل التمر أيضاً أن التغطية تزيد من نسبة عقد الثمار عندما تكون هذه النسبة بدونها واطئة والعكس صحيح (12) .

3 ـ متوسط وزن الحاصل بالعذق:

يشير الجدول رقم (4) الى متوسط وزن الحاصل الكلي بالعذق الواحد ، حيث هناك تفوقاً احصائياً واضحاً بالنسبة لمعاملة التلقيح اليدوي عن باقي معاملات الرش التي تبدو متقاربة في نتائجها عدا معاملة الكليسيرين والتي سببت انخفاضاً ملموساً ، وكانت متشابهة مع التلقيح الهوائي في الموسم الثالث . أما كمية الحاصل في العذق الواحد بالنسبة للمكشوف فقد ظهر أنها أعلى منه في الموسم الثاني عن الموسم الثالث، بينما في المغطى كان العكس صحيحاً وهذا بسبب الظروف البيئية وتأثيرها على عقد الثمار . لوحظ في معاملة التلقيح اليدوي أن التغطية بالاكياس خلال موسم التلقيح الثالث أدت الى زيادة كبيرة في وزن الحاصل ، حيث وجد في دراسة على صنفي الزهدي والحلاوي أن تكييس النورات بعد التلقيح يؤدي الى زيادة وزن وحجم الثمار (3) . لم يكن هنالك تأثير ظاهر على الحاصل ناتج عن اضافة البورون أو الجبريلين أو الاثنين معاً الى محلول الرش ، بينما وجد على العنب أن البورون يزيد من كمية الحاصل (7) ، وكذلك الجبريلين في أشجار المانجو (13) .

4 ـ المحتوى الرطوبي للثمار:

يتضح من الجدول رقم (5) ان النسبة المئوية للمحتوى الرطوبي في الثمار في معاملة البورون في الموسمين الثاني والثالث، حيث تشابهت احصائياً مع معاملة التلقيح اليدوي في الموسم الاخير . أما في الموسم الاول فقد كانت مشابهة لبقية المعاملات . معاملة الجبريلين لم يكن لتأثيرها اتجاه ثابت فهي تقلل نسبة الرطوبة في الموسم الثالث (مكشوف) ، وبينما لم يظهر لها تأثير مميز في الموسمين الاول والثاني . عموماً تزداد نسبة الرطوبة في المغطى عن المكشوف في معظم معاملات الرش للموسمين الثاني والثالث عدا الرش بمعلق حبوب اللقاح لوحده ، حيث لم يكن

المانجو (13) ، حافظت حبوب اللقاح على حيويتها بنسبة عالية في جميع الاوقات في محاليل الكليسيرين مقارنة بالمحاليل الاخرى التي لم تظهر فروقات كبيرة فيما بينها ، وأيضاً وجد في دراسة اخرى ان حبوب اللقاح لنخيل جوز الهند قد احتفظت بحيويتها لمدة ساعات عند خلطها مع محلول الكليسيرين والسكروز (5) .

2 ـ عقد الثمار:

الجدول رقم (3) يوضح النسبة المئوية لعقد الثمار ، حيث كانت جميع المعاملات متقاربة عدا معاملة التلقيح اليدوي كانت أعلى بكثير ، ولم تلاحظ تأثيرات واضحة لاضافة البورون أو الجبريلين الى معلق حبوب اللقاح ، بينما أظهر البورون عند رشه على أزهار العنب (7) والجبريلين على أشجار المانجو (13) تحسين نسبة العقد . بالرغم من عدم ملاحظة فروقات احصائية بين معاملات التلقيح بالرش ، وكذلك ارتفاع حيوية حبوب اللقاح في محاليل الكليسيرين ، الا أن معاملة الكليسرين أعطت نسبة عقد للثمار قليلة ومقاربة للتلقيح الهوائي وهذا قد يعزى الى أن الكليسيرين بطيء التبخر مقارنة بالماء ، وكذلك لكونه محلولا زيتياً يصعب التصاقه على مياسم الازهار بالرغم من اضافة المادة الناشرة واللاصقة . في دراسات سابقة وجد أن عقار الثمار لم يتأثر عند رش الازهار بالماء على فترات صفر ، 30 و 60 دقيقة بعد التلقيح في الظروف المناسبة للجفاف السريع (11) ، بينما وجد أن رش معلق حبوب اللقاح بمحلول سكري 10% يزيد من نسبة العقد (2) .

عموماً كانت نسبة العقد في الموسمين الاول والثاني أكثر من الموسم الثالث في المكشوف ، بينما نتيجتها عكس ذلك في التغطية بالنسبة للموسمين الثاني والثالث ، وهذا يعزى الى أن التغطية تؤدي الى تغيير الظروف البيئية المحيطة بالازهار مما يؤثر على عقد الثمار ، حيث يلاحظ بشكل واضح في الموسم الثاني اذ كانت الظروف البيئية فيه ملائمة لعقد جيد للثمار وعلى عكس ذلك في الموسم الثالث . في

3 - المحتوى الرطوبي للثمار في مرحلة التمر: أخذت 10 غم من الثمار وقطعت الى قطع صغيرة ووضعت في فرن حراري تحت درجة 70° م ولمدة 48 ساعة. ثم قدر وزنها الجاف وحسب المحتوى الرطوبي للثمار وفق المعادلة التالية: -

$$\text{المحتوى الرطوبي (٪)} = \frac{\text{الوزن الطازج - الوزن الجاف}}{\text{الوزن الطازج}} \times 100$$

4 - النسبة المئوية للمواد الصلبة الذائبة الكلية للثمار في مرحلة التمر: تم تقديرها بجهاز Abbe refractometer (6).

5 - النسبة المئوية للبروتين: تم حسابها في الموسمين الاول والثاني للأزهار والثمار في مراحل مختلفة، وذلك باستخراج النسبة المئوية للنتروجين الكلي مضروباً في 6.25 (10).

حللت النتائج احصائياً عند درجة احتمال 5% وقورنت متوسطات المعاملات بطريقة New L.S.D. (14).

النتائج والمناقشة

1 - حيوية حبوب اللقاح:

يبين الجدول رقم (2) النسبة المئوية لحيوية حبوب اللقاح في محاليل مختلفة وعلى فترات مختلفة بين 15-180 دقيقة، حيث تشير النتائج الى أن النسبة المئوية لحيوية حبوب اللقاح في المحاليل المختلفة تتناقص بمرور الوقت اذ تنخفض بعد ثلاث ساعات الى 39.68%، وتبقى أكثر من نصف حبوب اللقاح حية في معظم المحاليل بعد مضي ساعة (بمعدل 54.05% للمحاليل المختلفة)، وهذا مؤشر جيد على امكانية استخدام طريقة التلقيح بالرش.

لم يكن للبورون أو الجبريلين تأثير كبير على حيوية حبوب اللقاح مقارنة مع معلق حبوب اللقاح لوحده، في حين وجد في دراسات اخرى ان البورون حافظ على حيوية حبوب اللقاح في محاليل الانبات (8)، كذلك كان تأثير الجبريلين في

لانبات حبوب اللقاح مثل الوسط المعدل لـ Brewbaker and Kwack والمحتوى على 15% سكروز و500 جزء بالمليون حامض بوريك و300 جزء بالمليون نترات كالسيوم و200 جزء بالمليون، كبريتات مغنيسيوم و100 جزء بالمليون نترات بوتاسيوم (8)، فقد اختبرت الحيوية باستخدام صبغة الاسيتوكارمين (9) على فترات 15 ، 30 ، 60 ، 120 و180 دقيقة وبنفس كمية حبوب اللقاح المستخدمة في محاليل المعاملات الاساسية هي 20 ملغم لكل 100 سم^3 ماء مقطر واضافة قطرة واحدة من المادة الناشرة واللاصقة Nu-film-P الى المحلول مع رجه باستمرار للحصول على معلق متجانس، ولفحص الحيوية أخذت قطرة من معلق حبوب اللقاح حال تحضيره على شريحة زجاجية واضيفت لها قطرة من الصبغة ووضع عليها الغطاء وفحصت تحت المجهر الضوئي حيث تم حساب عدد حبوب اللقاح الكلية في عشرة حقول ميكرسكوبية على الشريحة ولمعدل خمس شرائح وهو العدد الابتدائي لحبوب اللقاح، كذلك تم حساب حبوب اللقاح الحية التي تأخذ لون الصبغة الاحمر وفي كل فترة وبعد 15 دقيقة من اضافة الصبغة وبنفس طريقة حساب العدد الابتدائي واستخرجت النسبة المئوية للحيوية من المعادلة التالية :

$$\text{٪ لحيوية حبوب اللقاح في المحلول} = \frac{\text{عدد حبوب اللقاح الحية لكل فترة}}{\text{العدد الكلي الابتدائي لحبوب اللقاح}} \times 100$$

أما فيما يتعلق بالمعاملات الاساسية فقد تمت دراسة النقاط التالية وفي المواسم الثلاث : ـ

1 ـ نسبة العقد : استخرجت نسبة العقد المئوية بأخذ عشرة شماريخ من كل معاملة خلال شهر حزيران وحسبت باستخدام المعادلة التالية : ـ

$$\text{نسبة العقد المئوية} = \frac{\text{عدد الثمار المتبقية على الشماريخ}}{\text{عدد الازهار الكلية على الشماريخ}} \times 100$$

2 ـ متوسط وزن الثمار بالعذق (كغم) .

البورون على العنب *Vitis vinifera* (7) ، وكان لها تأثير إيجابي على كمية ونوعية الحاصل .

يهدف البحث الحالي الى رفع كفاءة طريقة التلقيح بالرش، باضافة مواد منشطة كالبورون و/أو الجبريلين الى معلق حبوب اللقاح لغرض زيادة نسبة العقد وتحسين نوعية وكمية المحصول .

المواد والطرق

أجرى البحث في أحد بساتين النخيل في منطقة الدورة بمحافظة بغداد في المواسم 1980 ، 1981 و1982 على أشجار النخيل (صنف زهدي) بعمر خمسة وثلاثين سنة تقريباً ومتماثلة النمو. وقد خضعت لمعاملات رش مختلفة بموجب تصميم القطاعات العشوائية الكاملة Randomized Complete Block Design وفق الجدول رقم(1) .

في الموسمين الأول والثاني تم اجراء كافة المعاملات على الشجرة الواحدة وبمعدل عذقين لكل معاملة وكررت على خمس أشجار، وكررت نفس المعاملات في الموسم الثاني مع التغطية بأكياس القماش عدا معاملتي الكليسيرين والتلقيح الهوائي (بدون تلقيح)، أما في الموسم الثالث فقد اجريت كل معاملة على نخلة منفصلة (ثمانية عذوق لكل معاملة، أربعة تركت مكشوفة وأربعة غطيت بأكياس قماش، عدا معاملة التلقيح الهوائي) وبواقع ثلاث مكررات . استخدمت حبوب لقاح الصنف غنامي أحمر، وتم اجراء التلقيح رشاً مرتين في الموسم، حيث كانت الرشة الاولى في 4/5 ، 4/3 و4/8 للمواسم الثلاثة بالترتيب على التوالي . أما الرشة الثانية فقد أجريت بعد اسبوع من الرشة الأولى . أما معاملات التغطية بالقماش، فقد جرى تغطية العذوق بعد الرشة الاولى وتم رفع الغطاء لتنفيذ الرشة الثانية وأعيدت تغطيتها، وتم رفع الغطاء بعد أربعة أسابيع من موعد الرشة الثانية . استعمل 100 سم^3 لكل عذق من معلق حبوب اللقاح بعد اضافة أربع قطرات من مادة Nu-film-P كمادة ناشرة ولاصقة . واستخدمت مرشة صغيرة سعة 1 لتر .

لغرض التعرف على حيوية حبوب اللقاح في المحاليل المختلفة للمعاملات الاساسية المستخدمة في التجربة بالاضافة الى بعض الاوساط المستعملة في المختبر

EFFECT OF SPRAYING THE INFLORESCENCES OF DATE PALM *(Phoenix dactylifera L.)* WITH POLLEN GRAINS SUSPENDED IN BORON, GA_3 AND GLYCERIN SOLUTIONS ON FRUIT SET AND YIELD

F.A. HUSSAIN, S.M. BADER, K.M. SEQAB AND E.N. SAMARMED

Department of Palms and Dates, Agriculture and Water Resources Research Centre, Fudhaliya, Baghdad-Iraq

ABSTRACT

A spraying trail method was conducted, using boron (B) and gibberellic acid (GA_3) and other solutions as activating media for date palm pollen grains during pollination. It is found, from laboratory test, that pollen viability starts to decrease within half an hour in all suspension media, with glycerin being relatively the best in this regard. The influence of B and GA_3 on fruit set and yield was trivial as it did not match the results of hand pollination, and it was not significantly different from the other media such as glycerin-sucrose and water. In addition, the different treatments had no influence on total soluble solids. It is revealed, furthermore, that protein content starts to decrease through out the stages of fruit development, starting from flowering to maturity of fruit

المقدمة

نظراً للأهمية الاقتصادية لنخلة التمر *Phoenix dactylifera L.* ولحاجة هذه الشجرة لاجراء عملية التلقيح بالايدي العاملة الماهرة، ولندرة تلك الايدي، وما يتطلب من جهد ووقت لتنفيذ هذه العملية، بات ضرورياً البحث عن وسيلة لاجرائها من المستوى الارضي آليـاً بوسائل وطرق مختلفة لتلافي الوقت الحرج المرتبطة به .

ظهر اتجاه باستعمال مواد عديدة لاغراض تنشيط عملية التلقيح، وزيادة نسبة الاخصاب وتحسين كمية ونوعية الحاصل . وقد استعمل بعضها رشاً على محاصيل متنوعة كالجبريلين على نخلة التمر (4) والمانجو *Mangifera indica* (13) كذلك

Date Palm J (3) 1: 5 – 22
Published 1984

تأثير رش النورات الزهرية لنخيل التمر *(Phoenix dactylifera L.)* بمعلق حبوب اللقاح في محاليل البورون والجبريلين والكليسرين على عقد الثمار والمحصول

فرعون أحمد حسين، صالح محسن بدر، خلود محمد صكب وانتصار نعمة سمرمد
قسم النخيل والتمور، مركز البحوث الزراعية والموارد المائية
الفضيلية ـ بغداد ـ العراق

الخلاصة

جربت محاولة لاستعمال البورون وحامض الجبريليك وبعض المحاليل الاخرى كأوساط محفزة لحبوب اللقاح المستعملة لتلقيح نخيل التمر بطريقة الرش. ونتيجة للفحص المختبري وجد أن حيوية حبوب اللقاح تنخفض في أوساط معلق حبوب اللقاح منذ النصف ساعة الاولى وتستمر على ذلك وكان وسط الكليسيرين أجود هذه الاوساط نسبياً. ووجد أيضاً أن تأثير البورون والجبريلين على عقد الثمار وكمية المحصول كان بسيطاً، حيث لم تصل النتيجة الى ما تكون عليه في عملية التلقيح اليدوي، كما أنها لم تكن ذات تأثير معنوي مقارنة ببقية الاوساط المستعملة كالكليسيرين ـ سكروز والماء، وبالاضافة الى ذلك فان المعاملات المختلفة لم تؤثر على نسبة المواد الصلبة الذائبة الكلية، وأخيراً فقد وجد أن نسبة المحتوى البروتيني تبدأ بالانخفاض كلما تقدمت الثمرة في مراحل تطورها بدءاً من الزهرة وانتهاءاً بالثمرة الناضجة.

المحتويات

رقم الايداع في المكتبة الوطنية ببغداد
440 لسنة 1981

5
1984

مجلة نخلة التمر

مجلة نصف سنوية تصدر عن مشروع المركز الاقليمي لبحوث النخيل والتمور في الشرق الأدنى وشمال افريقيا .

ص.ب . 10085 كرادة الشرقية ، بغداد ـ العراق . تلكس : IK — 212699
هاتف : المدير : 7762278 بدالة : 7765934

حزيران (يونية) 1984 — المجلد 3 — (العدد 1) : 5-22

طبعت في لبنان لدى مطبعة الوطن ـ بيروت ، الغبيري ـ شارع علامة .