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Processing Of Date Palm Kernel (Dpk) For Production Of Edible Jam

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Abstract: Powdered date palm (*Phoenix dactylifera*) kernel (DPK) was used to produce edible jam. Saccharose, pectin, water, citric acid, ascorbic acid and Gum Arabic were added to the jam. Design Expert software was used to determine the optimum amount of the ingredients for the DPK jam. The design showed that there were ten variations of jams to be produced according to the content of different materials where the parameters such as amount of saccharose, pectin and dietary fiber from Gum Arabic were varied to give the best acceptability of the DPK jam samples. The jam samples produced were evaluated in terms of the sensory evaluation which includes taste, texture, aroma, appearance and overall acceptability by the panelist selected from students of Biochemical-Biotechnology Engineering, International Islamic University Malaysia. The samples were evaluated based on a five point hedonic scale, where zero (0.0) represented "disliked extremely" and four (4.0) represented "liked extremely". All the data were analyzed by using Microsoft Excel spreadsheet. The results showed that 60% of panelists accept (> 3.1/4) the product while the others 40 % moderately accept (2.55 – 2.64/4) the DPK jam samples. The average of overall acceptability is 2.98/4. This study is the outcome of the research done to find the acceptability of the production of DPK jams.

Key words: Date palm kernel (DPK), jam, *Phoenix dactylifera,* sensory evaluation.

INTRODUCTION

Date palm tree (*Phoenix dactylifera L.*) is grown extensively in arid and semi-arid regions of the world; like northern Africa, the Arabian Peninsula and Iran (Ahmed, *et al*., 1995). Date palm constitutes the principal source of remuneration and the basis of economy for the people living in Sahara. The world production of dates has increased considerably during the last 30 years. Indeed, the production has tripled from 2,289,511 tonnes in 1974 to 6,772,068 tonnes in 2004 (FAO STAT, 2005).

Phenolic compounds of fruit seeds mainly phenolic acids and flavonoids, have been shown to possess such benefits as antioxidant (Peterson & Dwyer, 1998), anti-carcinogenic (Bailey & Williams,1993; Block, 1992), antimicrobial (Takechi, Tanaka, Nonaka, & Nishioka, 1985), anti-mutagenic (Liverio, Puglisi, Morazzoni, & Bombardelli, 1994) anti-inflammatory activities (Landolfi, Mower, & Steiner, 1984), as well as reduction of cardiovascular diseases (Diplock *et al*., 1998; Halliwell, 1997).

Considering the protein, fat, mineral and carbohydrate contents of date seed, date pits could be used to meet part of the nutritional requirements of animal feeds (Gamil-Abdel-Hafez, Fouad-Shalaby, & Akhal, 1980) (Sawaya, Khalil & Safi 1984). This by-product of date processing industries could be regarded as an excellent source of food ingredients with interesting technological functionality that could also be used in food as an important source of dietary fiber jam from date palm kernel.

Pits contained a large quantity of fiber that may have health benefits (Barreveld, 1993). The difference between the quantities of neutral detergent fiber and acid detergent fiber gives the hemicellulose content of the pit sample (Yousef *et al*., 1989). It should be noted, however, that the acid detergent fiber is very high, which may indicate the presence of substantial amounts of lignin and perhaps resistant starch in date pits. Furthermore, plant fibers can exhibit unique qualities, such as antioxidant capacity, inherent susceptibility to fermentation to release ferulic acid and glucose retardation indices. Due to their importance in developing functional foods from date pits, the carbohydrates should be characterized further, especially for the presence and of resistant starches (Popenoe, 1973). Thorough investigation of these fibers, as well as other interesting and associated components in date pits, will determine their potential uses as functional foods (Tariq *et al*., 2000). Date pits can be a source of dietary fiber without any negative impact on sensory quality of end-products if the pits are properly milled (Almana and Mahmoud, 1994).

Date palm (*Phoenix dactylifera*) is a principal fruit that is grown in many regions of the world, resulting in a surplus production of dates. Date seeds (pits) constitute approximately 10% of the fruit (Almana and Mahmoud, 1994). In the United States, date pits have been a problem to the date industry as a waste stream. Pulverized ground date pits are being used on a small scale, on dirt roads as a type of road base gravel. However, finding a way to make a profit on the pits would benefit date farmers substantially.

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Occasionally, in the Middle East, date pits are used in animal feed. Vandepopuliere *et al*. (1995) incorporated date pits in broiler starting diets at levels ranging from 5 to 27%. Diets, containing date pits, supported broiler weights and resulted in feed conversions comparable to, or better than, the control diet. Several investigations on the effects of pits in animal diets suggest the presence of substantial amounts of tannins, resistant starch (Hadarmi, 1999) and natural anabolic agents (Elgasim *et al*., 1995). Almana and Mahmaud (1994) evaluated date pits as an alternative source of dietary fiber in comparison with wheat bran, and suggested that they may provide a valuable contribution to dietary fiber intakes. Therefore, date pits were examined because they may have an extractable high value-added component, functional foods such as production of jam from date palm kernel (DPK), especially to our knowledge there is no study in the literature about the use of DPK for the production of jam.

The main objective of this project is to produce jam from date palm kernel (DPK) and to evaluate the product through sensory evaluation.

MATERIAL AND METHODS

Ascorbic acid, citric acid, pectin and saccharose were obtained from the department of biotechnology engineering, Kulliyyah of Engineering, IIUM, Malaysia. Date palm was purchased from the local market, Selangor, Malaysia. Dietary fiber from Gum Arabic was donated by the Gum Arabic Compony Ltd. Sudan.

Equipments:

Analytical balance (Ross), beakers, drying oven (Memmert), glass rods, hot plate (Erla), Laboratory blender (Waring Commercial and National), mortar and pestle, sieves and spatulas were used in the research.

Experimental:

Date palm kernels were soaked in warm water, washed with distilled water and then dried up in oven at 50° C. The dried seeds were then crushed initially with mortar and pestle, followed by laboratory high speed blender to get powder of date palm kernel and then sieved. The date pits powder was boiled in 100 mL distilled water for 15 minutes and saccharose, dietary fiber from Gum Arabic, pectin, citric acid and ascorbic acid were added followed by stirring using a glass rod. The mixture was rapidly cooled to ambient temperature by immersing the plastic container in the refrigerant.

Experimental Design for Production of DPK Jam:

Experimental design for date palm kernel (DPK) for production of jam was done using the Design Expert. Table 1 shows the level of parameter that was used in the process design for production of DPK jams using Design Expert software.

Table 1: Level of parameter

Factor	Level		
	-1.00	0.00	+1.00
Amount of saccharose (g)	5.00	7.50	10.00
Amount of sugar pectin (g)	0.34	0.87	1.41
Amount of dietary fibre (Gum Arabic) (g)	3.13	8.01	12.90

Preparation of Date Palm Kernel (DPK):

The seeds were extracted from the fruit, washed and dried in an oven at 50° C for 48 hours (Figure 1). The seeds were crushed using pestle and mortar followed by high speed laboratory blender and then sieved to obtain finely divided powder (Figure 2).

Fig. 1: Dry DPK in oven at 50°C

Fig. 2: DPK powder sieved to obtain the fine seed powder

Preparation of DPK Jams:

After sorting, the date pits had been washed and oven dried over two days before grinding. The obtained date pit powder was boiled in water (1:1; w/w) for 15 min. About 5.0g of saccharose was then added to 10.0g of date pit powder. This was followed by addition of dietary fiber (DF) from Gum Arabic, pectin, citric acid and ascorbic acid. The samples were boiled in a beaker using hot plate, with manual stirring by glass rod. Then, the jam was poured into plastic container (100 ml) with caps (Fig. 3). The Samples were then immediately cooled to room temperature and stored at 4° C prior to sensory analysis.

The amount of ingredients required for the production of date palm kernel (DPK) jam such as powder of DPK, water, citric acid and ascorbic acid were fixed at the value of 10 g, 100 ml, 0.5 g and 0.075 g, respectively. Moreover, in the jam formulations saccharose was used as sweetener, pectin or Gum Arabic dietary fiber (DF) as thickener, citric acid as acidulated agent and ascorbic acid as antioxidant.

Fig. 3: Samples in the plastic container

Sensory Evaluation:

The samples were presented in a perfectly homogeneous way, i.e. identical conditions of conservation, preparation and presentation. Jams were evaluated for taste, texture, aroma, appearance and overall acceptability. The samples were evaluated based on a five point hedonic scale, where one represented “disliked extremely” and five represented ‘‘liked extremely” (Larmond, 1977). All sensory attributes were evaluated by three batches each one consisting of ten (10) semi-trained panelists selected from students of Biochemical-Biotechnology Engineering, International Islamic University Malaysia (IIUM). All the data were analyzed using Microsoft Excel spreadsheet.

RESULTS AND DISCUSSION

Date seeds serve as a good source of natural antioxidants and could potentially be considered as a functional food or functional food ingredient. Detailed information on nutritional composition and health-promoting components of date seeds will enhance our knowledge and appreciation for the use of date pits in a variety of foods and specialty products, including their use as functional foods and ingredients in nutraceuticals, and may be pharmaceuticals as well as in the production of nutritional jam. In many ways, date pits, which are cheap with high energy content and may be considered as an almost ideal food, provided a wide range of essential nutrients and potential health benefits and also help reducing environmental pollution.

Sensory Evaluation Analysis:

Table 2 shows sensory evaluation scores of all formulation of DPK jams done by one batch of ten (10) semi trained panelists (students of IIUM).

Table 2: Sensory evaluation scores of all formulation of DPK jams*

un	factor 1: saccharose	facto r 2: pectin	Factor 3: DF	resp onse taste	resp onse texture	respons e aroma	respons e appearance	response overall acceptability
	10.00	1.41	12.90	3.13	3.50	3.13	3.63	3.19
	5.00	1.41	3.13	2.13	2.88	3.00	3.00	2.56
	7.50	0.87	8.01	3.13	3.50	3.25	3.63	3.44
	10.00	1.41	12.90	3.14	3.51	3.12	3.60	3.17
	5.00	0.34	12.90	2.70	3.10	3.30	3.36	3.10
	5.00	1.41	3.13	2.15	2.88	2.90	3.10	2.55
	5.00	0.34	12.90	2.71	3.12	3.29	3.35	3.11
	7.50	0.87	8.01	3.14	3.48	3.23	3.60	3.45
	10.00	0.34	3.13	2.64	2.51	3.14	2.87	2.64
0	10.00	0.34	3.13	2.65	2.49	3.12	2.86	2.62

* DPK= Date palm kernel; DF=Dietary fiber; Results are mean of 10 x 3 panelists (three batches)

Figure 4 showed that the sensory evaluation scores start from run 1 until run 10. It showed that the five responses for ten experiments that evaluate the date palm kernel (DPK) jam for taste, texture, aroma, appearance and overall acceptability.

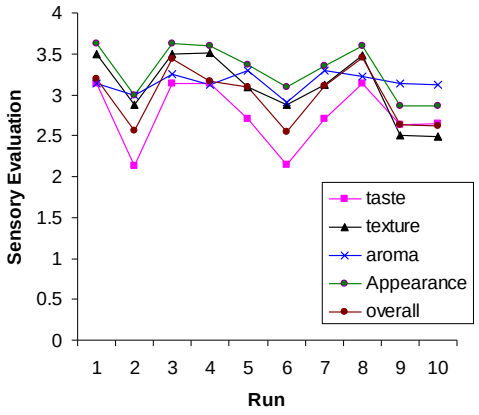

Fig. 4: Sensory evaluation for each runs

Figure 5 showed the responses of the taste and texture for this experiment. It showed that for run 9 and 10 the panelist moderately like the taste and also the texture of the sample compare to the other run. Responses for the taste and appearance are shown in Fig. 6. From run 9 to run 10 it clearly showed that the taste and appearance of the sample closely get the same value of sensory evaluation.

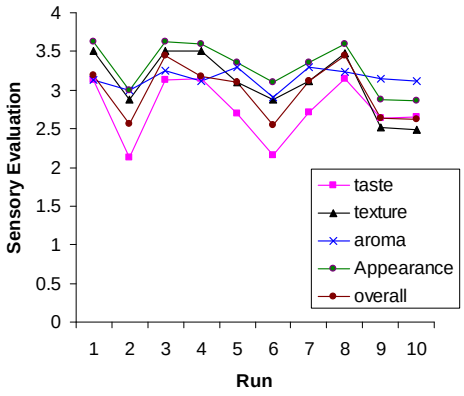

Figure 5: Responses on taste and texture

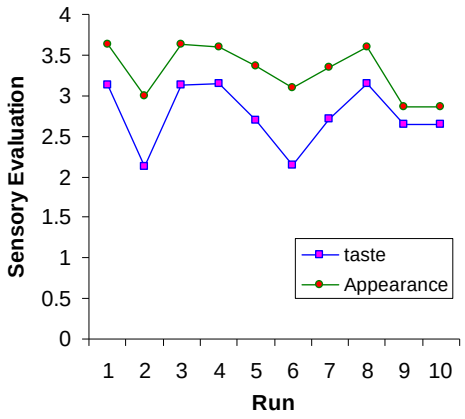

Fig. 6: Responses on taste and appearance

Table 3 shows the average, maximum and minimum values for each response for ten run of experiment. The average values were obtained from the mean of the sample while for maximum and the minimum values were getting by comparing the highest and lowest value of the responses.

Table 3: Average, maximum and minimum values

run	taste	texture	aroma	appearance	overall acceptability
1	3.13	3.50	3.13	3.63	3.19
2	2.13	2.88	3.00	3.00	2.56
3	3.13	3.50	3.25	3.63	3.44
4	3.14	3.51	3.12	3.60	3.17
5	2.70	3.10	3.30	3.36	3.10
6	2.15	2.88	2.90	3.10	2.55
7	2.71	3.12	3.29	3.35	3.11
8	3.14	3.48	3.23	3.60	3.45
9	2.64	2.51	3.14	2.87	2.64
10	2.65	2.49	3.12	2.86	2.62
Average	2.75	3.10	3.15	3.30	2.98
Maximum	3.14	3.51	3.30	3.63	3.45
Minimum	2.13	2.49	2.90	2.86	2.55

From Table 3, response for taste, texture, aroma, appearance and overall acceptability give average value of 2.75, 3.10, 3.15, 3.30 and 2.98 showed that the panelists like moderately to the samples. Besides that, from the ten experiments to prepare the DPK jam samples it showed that the panelists like the appearance of the samples which give maximum value up to 3.63.

The amounts of the three independent variables used in the formulation and responses on taste and aroma are shown in Table 4. This is followed by the graph of the both responses for each run (Fig. 7). It showed that the aroma for each experiment was considered as same since there was addition of any flavor in the DPK jam samples produced. Besides that, for run 1, run 3, run 4 and run 8 the relationship between taste and aroma were closely related. It is apparent that the panelists moderately appreciated to the aroma as well as the taste of the samples.

Table 4: Formulation and responses on taste and aroma

run	saccharose	pectin	dietary fiber	sensory attribute	
				taste	aroma
1	10.00	1.41	12.90	3.13	3.13
2	5.00	1.41	3.13	2.13	3.00
3	7.50	0.87	8.01	3.13	3.25
4	10.00	1.41	12.90	3.14	3.12
5	5.00	0.34	12.90	2.70	3.30
6	5.00	1.41	3.13	2.15	2.90
7	5.00	0.34	12.90	2.71	3.29
8	7.50	0.87	8.01	3.14	3.23
9	10.00	0.34	3.13	2.64	3.14
10	10.00	0.34	3.13	2.65	3.12

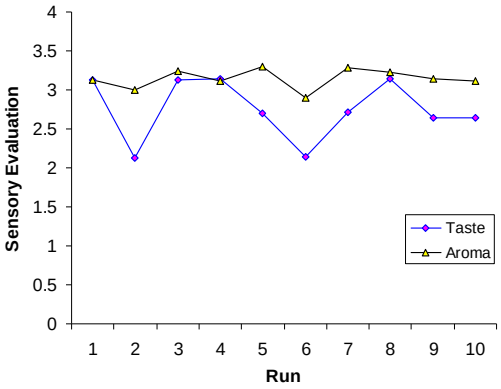

Fig. 7: Responses on taste and aroma

The results of regression coefficient for the responses and their corresponding coefficients of determination (R^2) are summarized in Table 5. The closer the value of R^2 is to unity the better the empirical model. The smaller the value of R^2 the less relevance the dependent variables in the model have to explanation of the behaviour variation (Mendehall, 1975).

Table 5: Regression coefficient of the taste and aroma

	sensory attribute	
run	taste	aroma
1	3.13	3.13
2	2.13	3
3	3.13	3.25
4	3.14	3.12
5	2.7	3.3
6	2.15	2.9
7	2.71	3.29
8	3.14	3.23
9	2.64	3.14
10	2.65	3.12
R^2	0.9996	0.9559

From Table 5, it is seen that the values of R^2 for taste and aroma responses were 0.9996 and 0.9559, respectively, with significant P values (less than 0.01). This indicated that for both taste and aroma, the models can be used.

From Table 6, it is seen that the values of R^2 for taste and overall acceptability responses were 0.9996 and 0.9991. This indicated that for both taste and overall acceptability, the models can be used.

Table 6: Regression coefficient of the taste and overall acceptability

	sensory attribute	
run	taste	overall acceptability
1	3.13	3.19
2	2.13	2.56
3	3.13	3.44
4	3.14	3.17
5	2.7	3.1
6	2.15	2.55
7	2.71	3.11
8	3.14	3.45
9	2.64	2.64
10	2.65	2.62
R^2	0.9996	0.9991

Figure 8 showed that for run 1, run 4, run 9 and run 10 the relationship between taste and overall acceptability were closely related. From this sensory analysis, it can be said that the panelists moderately appreciated the formulation for run 1 and run 4.

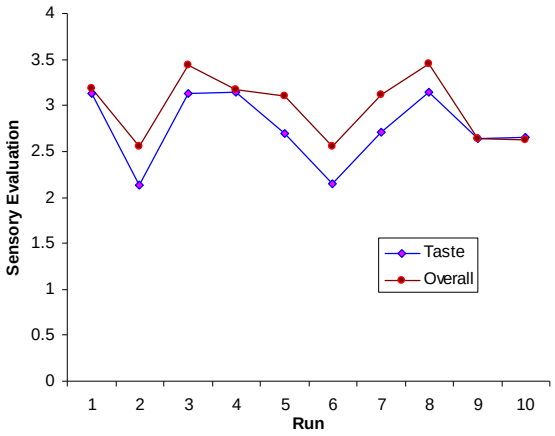

Fig. 8: Responses on taste and overall acceptability

Conclusion:

Pits of date palm could be an excellent source of functional food components with the exclusion of phytic acid. Date pits can be used in food as an inexpensive source of dietary fiber and other functional components, e.g. resistant starch. Considering the protein, fat, mineral and carbohydrate contents of date seed, we can conclude that date pits could be used to meet part of the nutritional requirements to produce the jam. Jams could be considered as a potential source of sugar but also of fiber and phenolic compounds which have many health benefits. Date palm kernel (DPK) can be act as an energetic food that could be used in the manufacture of value added products such as jam with commercial value. The use of date pits may also be attractive to consumers as a positive alternative to conventional fruit in nutritional jam production.

From the ten experiments of production of jam from date palm kernel (DPK) and the overall acceptability among the samples of run 1, 3, 4 and 8, it can be concluded that the panelists mostly likes appreciated the samples from run 3 and run 8. The results based on five sensory attributes showed that the panelists preferred the product with medium level of ingredients combination of 27.8% saccharose, 3.2% pectin and 29.7% Gum Arabic.

This study was conducted at laboratory scale. The date palm kernel (DPK) jam product should be further investigated and analyzed thoroughly before scaling up and produced commercially. It is also recommended that the results can be improved by optimizing the parameters such as color and flavor (add pieces of dates or add chocolate) to the DPK jams since this project only focuses on the production of the jam without changing the aroma and color of the samples. Moreover, it is also recommended that the pits should be properly milled by using the suitable equipment to improve the sensory quality of end-products.

REFERENCES

Ahmed, I.S.A., K.N. Al-Gharibi, A.S. Daar, & S. Kabir, 1995. The composition and properties of date proteins. *Food Chemistry*, 53: 441-446.

Almana, H.A., & R.M. Mahmoud, 1994. Palm date seeds as an alternative source of dietary fibre in Saudi bread. Ecology of Food and Nutrition, 32: 261-270.

Bailey, G.S., & D.E. Williams, 1993. Potential mechanisms for food related carcinogens and anti-carcinogens. Food Technology, 47: 105-118.

Barreveld, W.H., 1993. Dates palm products, FAO agricultural services bulletin No. 101.

Block, G., 1992. The data support a role for antioxidants in reducing cancer risk. Nutrition Reviews, 50: 207-213.

Diplock, A., J. Charleux, G. Grozier-Willi, K. Kok, C. Rice-Evans, M. Roberfroid, *et al.* 1998. Functional food sciences and defence against reactive oxidative species. British Journal of Nutrition, 80: 77-82.

Elgasim, E.A., Y.A. Al-Yousef, & A.M. Humeida, 1995. Possible hormonal activity of date pits and flesh fed to meat animals. Food Chemistry, 52: 149-152.

FAO STAT., 2005. Rome: Food and Agriculture Organization of the United Nations.

Gamil-Abdel-Hafez, M., A. Fouad-Shalaby, & I. Akhal., 1980. Chemical composition of 15 varieties of dates grown in Saudi Arabia. *Fourth Symposium on biological aspects of Saudi Arabia*, pp: 89-91.

Hadarmi, G., 1999. Personal communication. Chair, Department of Animal Production, Faculty of Agricultural Sciences, United Arab Emirates University, UAE.

Halliwell, B., 1997. Antioxidants and human disease: A general introduction. Nutrition Reviews, 55: 44-52.

Landolfi, R., R.L. Mower, & M. Steiner, 1984. Modification of platelet function and arachidonic acid metabolism by bioflavonoids. Biochemical Pharmacology, 33: 1525-1530.

Larmond, E., 1977. *Laboratory Methods for Sensory Evaluation of Food. Publication 1637.* Ottawa: Food Research Institute.

Liverio, L., P.P. Puglisi, P. Morazzoni, & E. Bombardelli, 1994. Antimutagenic activity of procyanidins from Vitis vinifera. Journal for the Study of Medicinal Plants, 65: 203-209.

Mendehall, W., 1975. *Introduction to probability and statistics.* North Settuate: Duzbury Press.

Peterson, J., & J. Dwyer, 1998. Flavonoids: Dietary occurrence and biochemical activity. Nutrition Research, 18: 1995-2018.

Popenoe, P., 1973. The Date Palm. Edited by Henry Field. *Field Research Projects, Coconut Grove, Miami, Florida, U.S.A.*

Takechi, M., Y. Tanaka, G.I. Nonaka, & I. Nishioka, 1985. Structure and antiherpetic activity among the tannins. Phytochemistry, 24: 2245-2250.

Tariq, N., D.J.A. Jenkins, E. Vidgen, N. Fleshner, C.W.C. Kendall, J.A. Story, *et al.* 2000. Effect of soluble and insoluble fibre diets on serum prostate specific antigen in men. The Journal of Urology, 163: 114-118.

Vandepopuliere, J.M., Y. Al-Yousef, & J.M. Lyons, 1995. Dates and date pits as ingredients in broiler starting and Coturnix quail breeder diets. Poultry Science, 74(7): 1134–1142. J.S. Hamada *et al.* / *Food Chemistry* 76 (2002) 135–137 137.

Yousef, Al-Yousef, Belyea, R.L., J.M. Vandepopuliere, 1989. Sodium hydroxide treatment of date pits. *Proc. 2nd Symposium on the Date Palm, Saudi Arabia.*