CHARACTERISTICS OF FROZEN DESSERTS FORMULATED WITH DATE SEED SOLIDS

by

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ABSTRACT

A chocolate-flavored ice cream type frozen dessert formulated with Milk Solid Non-Fat (M.S.N.F.) or M.S.N.F. and Date Seed Solids (D.S.S.) or D.S.S. only, was processed and analyzed. Ohter ingredients used were sugar, cocoa fat, cocoa powder, stabilizer/emulsifier and water. Preparation included pin and stud milling of date seeds to produce D.S.S., sifting to the smallest particles, mixing the ingredients together, and pasteurizing at a temperature of 160^{o}F and homogenizing at a pressure of 3500 p.s.i. After cooling to 40^{o}F for 24 hours, the desserts were frozen using the batch processing at a temperature of 23^{o}F. The final products were hardened at a temperature of -23^{o}F.

The resulting frozen desserts with 25 and 50% D.S.S. had sensory properties similar to the control but had a slightly coarser texture. D.S.S. can be used at levels up to 50% replacement for M.S.N.F. Coarse texture in the product was the only observed problem. Additional refinements of developments in the D.S.S. milling process could be expected to correct this problem. This was beyond the scope of this project.

INTRODUCTION

World population is increasing faster than improvement in food production and distribution. This is especially true concerning the important protein/calorie relationship. The quality, price and availability of these items are influenced by increased cost and general imbalance of the ingredients. Researchers are searching for new sources of these constituents that may benefit areas experiencing food shortages.

In Europe, for example, most non-fat milk solids (N.F.M.S.) and whey solids from cheese production are still used as animal feed rather than as an ingredient for human food (Johnson 1975). However, many materials including cotton products, certain cereals such as oats and date pits have not been used at all or only sparingly in human diets in many areas of the world. One possible approach to assist in the alleviation of world shortage is to divert or convert certain materials used for animal feed to human food uses.

Date pits are generally considered as waste material from processing industries (i.e., production of pitted dates, date syrup, alcohol and liquid sugar) and as a result are not currently used for human consumption.

World annual date production (Passat 1971) is estimated to be between 850,000 and 1,200,000 metric tons. In Iraq, the annual production is from 280,000 to 480,000 metric tons (Table 1) and the output in Egypt (El-Shazly, Ibrahim and Karam 1963) is 332,000 metric tons yearly. Approximately 1% of this represents the total potential date pit availability. However, this amount may not all be available, since only the pits from processed dates can be collected. Date pits are potentially a very good source of food solids material which can be used in the formulation of many food products of good quality and suitable price. Date pits are available in a very large quantity in various geographical areas. The availability of this material is of interest as a source of solids for food product formulation. For example, date pit solids could be substituted, at least in part, for other ingredients in ice cream-type frozen desserts.

Frozen desserts standards of identity of the U.S. Food and Drug Administration (U.S.F.D.A.) have included certain products with label statements of optional ingredients. These include (1) ice cream; (2) frozen custard, French ice cream, and French custard ice cream; (3) ice milk; (4) fruit sherbet; and (5) water ices (Arbuckle 1977, p. 25). A wide range of ingredients may be grouped into (1) dairy products and (2) non-dairy products. The dairy products group furnishes the basis dairy ingredients

Table 1. Annual Iraqi Date Production (metric tons).*

Year	Production
1965-1966	280,000
1966-1967	380,000
1967-1968	330,000
1968-1969	360,000
1969-1970	480,000
1970-1971	284,000

* Passat 1971.

milk fat and milk solids-not-fat (M.S.N.F.). M.S.N.F. are relatively more expensive than date seed solids (D.S.S.).

Considerable research attention has been devoted to the use of new food sources for human use. Examples are in dried whey, soya flour and various plant protein isolates. It may be possible, therefore, to partially replace some of the more expensive M.S.N.F. with date seed solids in certain formulations.

The purpose of this work was to study the characteristics and manufacture of an ice cream-type frozen dessert formulated with milled date seed solids. The main ingredients of the frozen dessert are water, milled date seed solids, non-fat milk solids, sugar, fat, stabilizer, emulsifier and flavor.

REVIEW OF LITERATURE

Dates are the fruit of Phoenix dactylifera. They are important foods in the human diet of several countries of the world such as Iraq, Egypt, Saudi Arabia, Algeria, Iran, Tunisia and Morocco. Dates provide good nutritional value for the human diet. They contain vitamins, protein, carbohydrates, fats and minerals (Tables 2 and 3). Agriculture (Dowson and Aten 1962) Handbook No. 8, composition of food (1950), gives the following contents per 100 gm., as purchased: Vitamin A, 200 international units; thiamine (B_1) 0.35 milligram; riboflavin (B_2) 0.38 milligram and niacin 8.6 milligrams. Dowson and Aten (1962, p. 47) sum the matter up as follows: "Dates contain carotene and B comples vitamins, both in notable amounts, but no Vitamin C." However, some Iraqi dates show some Vitamin C (Table 4).

The date palm (Dowson 1921 p. 1) has a moderately stout stem with persistent bases of spiny petioles. Leaves are pinnate, pinnae scattered, rigid and lanceolate. Spadices are several, interfoliar, erect, afterwards drooping and branched. Dates may be considered a berry. The flower (Dowson and Aten 1962, p. 6) has three carpels, but on pollination, only one develops and two abort. The

Table 2. Percentage Composition of Edible Portion of Iraqi Hallaawi Dates.*

Constituent	Percentage
Total carbohydrates other than crude fiber	73.7
Reducing sugar as invert	73.5
Water	19.0
Ash	2.2
Crude fiber	2.2
Fat (ether extract)	1.9
Protein (N x 6.25)	1.7
Sucrose	0.0

*Dowson and Aten 1962.

Table 3. Mineral Composition of Edible Portion of Dates.

	Halaawi	Sayer
	------- %	-------
Total ash, moisture-free basis	2.02	1.94
Alkalinity of ash*	16.7	15.9
Composition of ash:		
K_2O	42.7	40.8
Cl	13.00	16.64
P_2O_5	9.50	7.47
SiO_2	7.01	7.24
SO_3	6.44	7.62
MgO	5.86	6.77
CaO	4.51	9.96
Na_2O	2.47	2.65
Al_2O_3	0.48	----
Fe_2O_3	0.26	0.23
MnO	0.21	0.30
CuO	0.015	0.014

* Cc. of N Hcl required to neutralize the ash from 100 grams of moisture-free edible portion (Cleveland and Fellers 1932).

Table 4. Vitamin C and Water in Iraqi Dates (mg/100 gm).*

Variety	Vitamin C	Water
Khadhraawi	2.7	15.69
Saiidi	1.72	16.76
Dairi	1.7	16.39
Hallaawi	1.62	15.98
Zahdi	1.00	15.31
Jibjab	0.82	8.66

* Passat 1971.

fruit usually more or less oblong or ellipsoidal in shape (Fig. 1). The seed, pit or stone is bony and cigar-shaped, slightly pointed at the ends, about three times as long as it is wide, from gray to brown in color, with a small embryo. The date seed is unusual, in that the food material for the growing embryo is stored, not as starch, as in maize but as cellulose.

The temperature (Abusida 1979) requirement for proper ripening of most varieties is computed as a summation of daily mean temperature above 20°C for the time (in days) between May and October 31st in areas north of the equator. This summation ought to be not less than 3750 heat units or an average daily temperature of 29°C for the six months. At a minimum atmospheric temperature of 10°C, growth ceases.

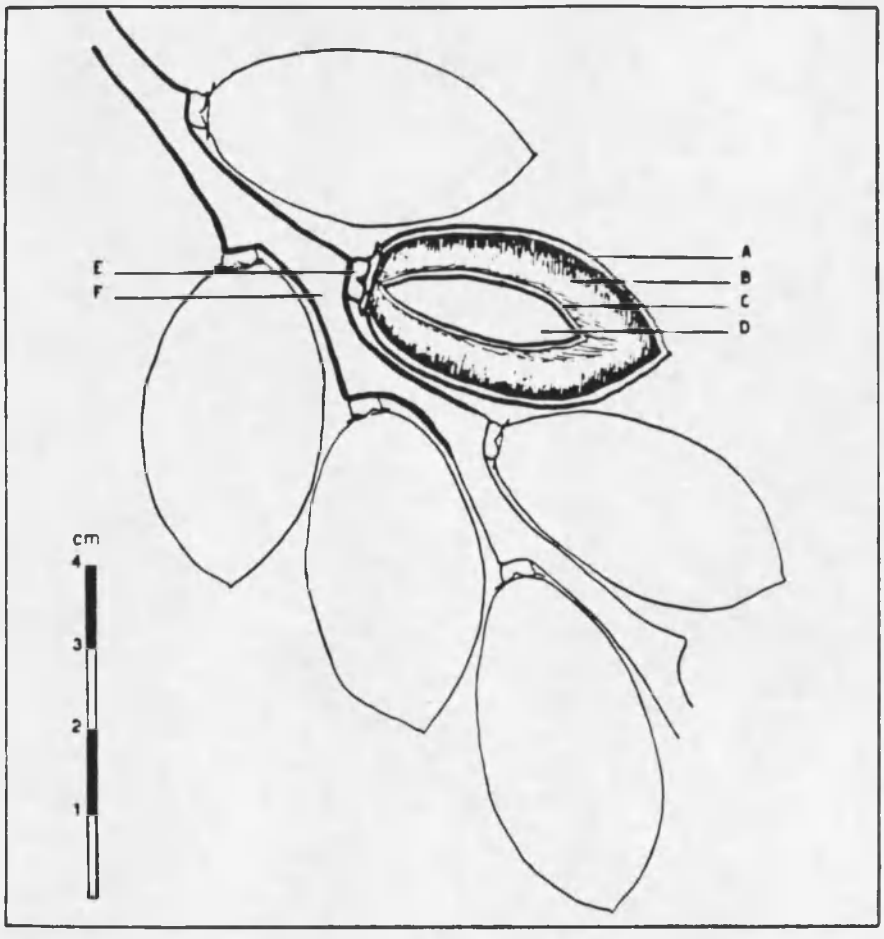

Figure 1. Longitudinal Section of Date, Showing Its Parts.

(a) epicarp, skin; (b) mesocarp, flesh; (c) endocarp, white, papery envelope of seed; (d) seed, pit or stone; (3) perianth, calyx, or in the the trade, "cap"; (f) stalk or spikelet. The heavily shaded outer part of the flesh represents that part which has been almost entirely converted to sugar. The lighter part of the flesh represents the "rag", the more fibrous part, consisting chiefly of cellulose not yet converted to sugar. The lighter shading round the seed represents the hollow in the rag in which it lies. (Dowson and Aten 1962)

Normal growth takes place at a mean daily temperature of 20°C or above, nevertheless date palm will withstand -12°C or even less for short periods of time.

Some research has shown the value of cereal flour for human consumption such as milled oat flour, whole oat flour and corn flour, especially as antioxidants, in dairy products (Mueller and Mack 1939). Hall (1977) shows that the largest market for soy protein isolates is in dairy and simulated dairy products such as emulsifiers, stabilizers and collodial agents. Various stabilizers (Slyusar 1978) were studied in ice cream and the best results were obtained in sensory properties (flavor, aroma, consistency and color) with agar added to the mix at 0.15%, apple pectin at 0.25%, and soya protein 1.5%. It was found (Kreal et al. 1977) that soya protein concentrates, used as stabilizing and emulsifying agents in ice cream manufacture, are unlikely to find broader application in the dairy industry in competition with milk protein concentrates.

Recently, several researchers have developed vegetable protein mixtures for feeding both children and adults. Vegetable proteins that have received the greatest attention are those derived from soybean, cotton seed, peanut, sesame, ground nuts, pecans and corn. Soy flour (Hall 1977) made in the United States, was the first product used. It was

sold as "health flour" and had a very limited acceptability because of its bitter flavor. This undesirable flavor (Morr 1979) was due to a low concentration of certain minor organic compounds and also caused undesirable color and anti-nutritional properties of the soy flour or its vegetable protein.

Cantafora (1977), Circle (1974), Crowhurst (1974), Johnson (1975), Rajor and Gupta (1974), Rajor and Gupta (1975) and Valle et al. (1979) found that a wide variety of soya protein products (full fat or defatted soya flour, low fat expeller type soya flour, soya protein concentrates and isolated soya protein) can be used singly or in blends as substitutes or partial replacements for dairy products to give good flavor for use in beverages, frozen desserts and cheese.

Anonymous (1976) used soya flour in processed ice cream and found that it had advantages of increased water binding and emulsifying power, longer shelf life, more water holding capacity and improved color. Kim and Byun (1978) prepared ice cream containing 0, 25 and 50% substitution of M.S.N.F. with soy protein isolate (SPI). The ice creams with either 25 or 50% SPI showed the same textural quality as the control but they had a significant "beany" off-flavor.

Wilding (1979) showed that ice cream is one of the more sensitive test systems in which to evaluate the flavor

and functional properties of vegetable proteins for use in dairy product analogs. Processed soybean isolated protein, which differs from commercial soy isolates, can be used as a 50% replacement for milk solids with no discernible differences from a control product. It can be shown that the uses of these new protein sources can help to control spiraling food costs; to use indigenous raw materials for dairy products in countries not now consuming significant quantities of dairy foods; and to develop and use new product types not currently being marketed.

A solidified product (Glabe, Anderson and Laftsidis 1975) can be made from molasses and prepared by a process in which a high protein, high water soluble soy protein is incorporated with molasses to form a slurry prior to dehydration. The crispness and rapidity of crystalline formation is enhanced when the slurry is subsequently dehydrated as a thin film on a heated surface. This product has been used in manufacture of an ice cream-type frozen dessert. It has (Anonymous 1977) been shown that a mixture of soya bean powder with ascorbic acid, casein, or whey protein, sugar, oil and flavoring can be processed and used in frozen dessert manufacture.

Preliminary trials (Rothwell 1976) using dried whey and soya flour in ice cream manufacture have shown promising results. Acceptable products have been obtained by using

7.5% M.S.N.F. and 2.2% demineralized dried whey plus 1.5% soya flour in place of 11.2% M.S.N.F.

Drusendahl (1963) used corn syrup solids as an economical source of ice cream solids. He showed that M.S.N.F. cost about twice as much as corn-syrup solids, and that it is possible to partially replace some milk solids (7.2% to 18% dextrose) were added to ice cream mixes and the effect on the properties of the mix studies. The viscosity of the mix was slightly increased, body and texture were improved by replacing the sucrose with as little as 13.3% of the corn sweetener (Young and Mull 1966).

Green leaves (Anonymous 1975) of cereal grasses have been pulverized and the separated juice is spray-dried or freeze-dried to yield a powder having a wide variety of food uses, including frozen dessert manufacturing.

Ramanna (1975) found that neutralized and spray-dried ground nut protein isolate could be used instead of M.S.N.F. to make non-dairy ice cream. The cost was slightly less than that of an all dairy mix with similar fat but lower protein content (Table 5). The process has been successfully tried in a large scale industrial unit and the frozen dessert was quite acceptable. Arbuckle (1977, p. 404) prepared a new non-dairy frozen dessert called Parevine for those who want to avoid consuming animal foods or dairy products because of religious or other reasons. This

Table 5. Ice Cream and Frozen Dessert Composition.*

Ingredients	Ice Cream	Frozen Dessert
Protein (%)	4.0	7.0
Fat (%)	12.0	12.0
Carbohydrate (%)	20.0	18.0
Calories/100 gm	204	208

* Ramanna 1975

product is described as not containing any milk, milk products, meat, or meat products, or any of their derivatives. The product made in semblance of ice cream and all food solids must be vegetable, egg solids or of non-dairy origin (Table 6).

Kodet (1979) briefly covers the properties of chemically modified starches (biochemically and physically) and their uses in cultured products and ice cream-type frozen desserts.

Partial hydrolysis (Sekul, Vinnett and Ory 1979) of peanut protein by papain was studied. It improved nitrogen (N) solubility and protein solubility between pH2 and pH8. The partially hydrolized peanut protein was bland in taste, odorless, light in color, furnished a good source of amino acids and fat, and can be used to produce formulated food

Table 6. Parevine Composition.*

Economy Mix Ingredients	(%)	Deluxe Mix Ingredients	(%)
Vegetable fat	10.0	Vegetable Fat	10.0
Sugar	15.0	Sugar	16.0
Hydrolized cereal solids	15.0	Whole egg solids or	9.0
Microcrystalline cellulose	1.5	Dry whole eggs or	9.0
Vegetable protein	2.0	Fresh whole eggs	26.0
Stabilizer	0.35	Stabilizer	
Salt	0.15	Salt	
Total Solids	32.0	Total Solids	35.50

*Arbuckle 1979.

with good viscosity and stable emulsion. It can be used to reduce overall cost by substituting it for other sources of protein such as M.S.N.F. It was thought to be suitable for various frozen desserts.

Date Pit Composition and Use

Date pits composition differ insignificantly between varieties. Their composition is similar to that of barley (Table 7). The differences include the fact that barley has more protein and less fat and fiber (Abusida 1979).

Table 7. Gross Composition of Date Pits and Barley.*

Ingredients	Date Pits	Barley
	%	
Nitrogen free extract	65.1	70.1
Moisture	14.1	10.2
Crude fiber	19.7	2.7
Ether extract	7.9	2.1
Protein	6.7	12.8
Ash	1.1	2.1

*Abusida 1979.

Harry (1936) reported the analyses of ground date stones of three different varieties of dates (Table 8). Dowson and Aten (1962 p. 316), Harry (1936) and Jamieson (1943) reported some characteristics of date stone oil (Table 9). Date stone oil can be extracted by using some organic solvents such as butane, hexane, and other petroleum spirits. The oil was pale, yellowish green liquid having a pleasant odor. It was found that date pit oil can be used for human consumption. On account of the small oil content of date pits, extraction of their oil does not appear to be of great interest to commercial operations involved with

Table 8. Analyses of Various Varieties of Ground Date Stones.*

	Mixed	Deglet Nour Variety	Iraq
		%	
Moisture	7.96	9.82	6.46
Ash	0.89	0.86	1.12
Protein	5.25	5.30	5.22
Carbohydrates (by difference)	65.53	58.53	62.51
Fiber	13.60	18.10	16.20
Oil	6.77	7.39	8.49

*Harry 1936.

Table 9. Characteristics of Date Pit Oil.

Characteristics	Mixed[a]	Deglet Nour[a]	Iraq[a]	All[b]
Sp. gr. at 15.5°C	0.9201	0.9203	0.9207	0.9198
Refr. index n_D^{40}	1.4580	1.4574	1.4580	
Sap. V.	206.1	212.	208.3	260.
Iod. No.	54.5	50.2	53.4	56.3
Unsaponifiable Matter (%)	1.98	0.51	0.40	1.28
Free acids (as oleic) (%)	0.5	0.2	0.3	
Reichert-Meissl Value	1.0	0.9	1.1	1.50
Polenske value	3.0	2.7	2.9	2.50
Insoluble fatty acid (%)	88.7	91.5	88.9	
Refraction value (Zeiss) at 25°C				58
Acid value (by Jamieson 1943)				0.6

[a] Harry 1936

[b] Dowson and Aten 1962

producing pitted dates. The separated fatty acids were solid and had a yellow or yellowish color and gave the following values:

	Mixed	Deglet Nour	Iraq
M.P. (^{o}C)	22.0	22.0	22.0
Solid point	17.5	17.5	17.55
Refr index n_D^{40}	1.4467	1.4465	1.4465
Iodine value	56.6	56.1	56.4

All the oil showed a bluish-purple fluorescence and the separated fatty acids fluoresced greenish-blue under ultra-violet light (Harry 1936). Date pit oils (Mehran and Filsoof 1975) of three Iranian varieties of dates were examined for their fatty acids composition. It shows (Table 10) a high concentration of certain fatty acids such as oleic ($C_{18:1}$) and lauric (C_{12}) and low concentration of others such as caprylic (C_8), arachidic (C_{20}) and linolinic ($C_{18:3}$). Oil content, m.p., iodine values and refractive index were slightly different in the three varieties and showed little differences from data obtained from other workers.

Date pit hemicellulose is composed of galactans and mannans which give galactose and mannose with acid hydrolysis (Goldner and Rogers 1939). The pits contain 48.85% mannan and 0.68% galactan. Galactonic lactone has been

Table 10. Date Pit Oil Characteristics.

Variety	Content (%)	Mp (C)	Iodine Value	n_D^{40}	Fatty Acid Composition (wt %)									
					$C_{8:0}$	$C_{10:0}$	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{20:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
Musaafti	8.5	15.5	49.7	1.4559	0.5	0.6	20.1	12.6	11.4	0.9	0.7	45.7	6.8	0.7
Kabkaab	5.0	17.0	51.2	1.4568	0.6	0.6	22.4	12.3	10.1	1.3	0.7	44.2	7.2	0.7
Sayir	6.9	19.5	52.2	1.4573	0.7	0.5	21.5	14.6	9.9	1.2	0.8	43.5	6.6	0.7

incorporated into tooth pastes and mouthwashes as a mucin solvent. However, it has been thought probable that mammonic lactones and derivatives could be prepared and substituted for galactonic lactone or a mucin solvent. Therefore, pits are a good commercial source of mannonic lactones. In the embryo, an enzyme, cytase, converts hemicellulose to dextrose when the seed germinates.

Buckaeu et al. (1976) found that certain hormones are present in the seeds of one variety of date palm tree (Zahdy) by using TL and GL chromatography. TL chromatography shows the presence of cholesterol, estradiol and estrone in date seeds. The amount of pure estrone and estradiol in the seeds of the corresponding date plam trees were: 1030 mg and 857 mg per kg of oven dry seed, respectively.

Date stones (Dowson 1921, p. 60) are occasionally collected from roads and gardens by urchins who sell them to charcoal makers. In part of Arabia and of northern Africa, date stones are ground and fed to camels and other livestock. They are also strung together as necklaces. Harry (1936) reported that date stones have been used for cattle feeding. In Iraq, cattle (Abusida 1979) have been fed date pits alone or in combination with macerated whole dates, barley or sesame seed meal. The use of up to 85% date pits with a protein supplement such as cotton seed

cake is added. They found that date stones contained a relatively high percentage of oil with a high coefficient of diegestbility. They mentioned that, because of difficulties in grinding date stones, they were not used frequently as animal feed. In an experiment involving fattening Awassi lambs, it was found that the digestibility or organic matter, nitrogen-free-extract, either extract and total digestible nutrients (T.D.N.) was increased by raising the proportion of date stones in the ration (Al-Kinani and Al-Wash 1975). The digestibility of crude protein and crude fiber were decreased under those conditions. In another experiment, lambs received 75% date stones and 25% alfalfa hay. They gained more than the lambs in the control group. Afifi, Abdou and El-Sayed (1966) reported that date stones fed to chicks could replace barley in a ration containing five to ten percent of the grain with an improvement in weight gain. In another experiment, he showed that date stones improved the growth of chicks when fed at a level of two percent in the ration. The protein of date pits is relatively indigestible by ruminant animals (Abusida 1979). The total digestible nutrients (T.D.N.) of date pits in animal feed is 82.7% and the net energy is 134.43 m Cal./100 kg. Date pit solids (Abusida 1979) can be utilized in human food products. They can be used successfully for making a beverage. They could probably

be used for making other foods such as high-fiber cereals as well as an ingredient for frozen desserts, confections and pastries.

Stages of Ripening

Four Arabic terms (Dowson and Aten 1962; Passat 1971) have been used for stages of ripening. These distinct stages are: "Chimri", "Khalaal", "Rutab", and "Tamar". The small spherical and cream-colored female date which flowers immediately before pollination, and the small, immature fruit for a short while after a few days from pollination, is called, in Iraq, "Hababouk".

Chimri

This stage starts with the appearance of nodes (small dates) on the stalk of the pedicel. It has a green color with a bitter taste because it contains a high percentage of tannin, as a layer a little below the skin of the date. In this stage, first, there is a rapid increase in weight and volume, a rapid accumulation of reducing sugar, a high active acidity and high moisture content. The second stage shows a reduced rate of gain in weight and volume, greatly reduced rate of accumulation of reducing sugars, slightly reduced active acidity and high moisture content. In this stage, the percentage of starch will be 12.79% (dry weight) in Samaani dates and decreases to 3.10% at the Rutab stage. Date cell walls are composed chiefly of

cellulose and hemicellulose. Together with the non-soluble solids, these components comprise 85% of the dry matter. As the proportion of sugar increases there is a concomitant decrease in cellulose.

Kahlaal

During this stage, the date will reach its final shape and size; also the seed reaches apparent maturity. The color of the skin will change from green to yellow, finely spotted with red, the skin remains solid and soft. There is a continued decrease in rate of gain in weight, low rate of gain in reducing sugar and rapidly increasing rate of gain in sucrose (Table 11). There are decreases in active acidity and moisture contents. Protein, pectin and mineral salt percent will decrease rather than in the chimri stage. In this stage, some varieties are commonly eaten in Iraq and other countries; for example, Braim, Barhi and Hasawi. The soluble solids material will be more than 55% at the end of this stage.

Rutab

This stage begins with appearance of a soft area which has a red or yellow color at the lower end of the date. Then, the color will change to dark brown or black and the date softens. This softness is due to invert sugar. The changing of the disaccharide to monosaccharides

Table 11. Changes in the Composition of the Californian Barhi Dates during Ripening.*

Stage of Ripening	Fresh Weight of Fruit (gm)	Fresh Weight	Dry Weight		
		Water	Reducing Sugars	Sucrose	Total Sugars
		%			
Chimri	0.5	81	17	5	22
"	5	86	43	5	48
"	14	85	45	14	59
Khalaal	16	64	17	62	79
Rutab (tree-ripe)	14	39	79	0.25	79

*Dowson and Aten 1962.

is very clear and can be followed by an increase in the percentage of invert sugar (glucose and fructose) and by a decrease in sucrose. The enzyme invertase is responsible for the inversion of sucrose to glucose and fructose. The presence of soluble tannins in the Khalaal stage does not prevent the invertase from working and being dissolved in extra cellular glycerine. Mineral salts and protein will continue to decrease. The soluble pectins decrease, in Chimri stage from about 2% (dry weight) to about 1% in rutab stage, protopectin decreases from about 4.5% to about

1% and total pectic substances from about 6.5% to about 2%. The last of the tannins under the skin is precipitated in an insoluble form, so that the date loses astringency that may have remained in the Khalaal stage from the Chimri stage and the date will taste sweet. Tannins and tannin-like compounds were found in amounts up to 6% (wet weight) of Californian Deglet Nour, Chimri. This percentage dropped to 1% in the Rutab stage.

Tamar

This is the final stage of ripening. The date loses enough water to make the sugar-to-water proportion sufficiently high to prevent fermentation. The texture of the date flesh gradually becomes firmer, the color of the skin and that of the underlying flesh darkens with time. Table 2 shows the percentage composition of Iraqi Halaawi dates in the Tamar stage. In Iraq, most of the sucrose in dates has completely inverted to glucose and fructose, such as in Halaawi and Khadhraawi varieties. Dayri, Zahdi and Ashrasi varieties contain some sucrose, but Deglet Nour, Deglet Beidh (Algeria) and Kinta (Tunisia) contain a relatively high percent of sucrose which will be drier than those that contain a high percent of invert sugar. The crude fiber content, in Zahdi dates, varies from 4.5 to 10.1%, depending on the geographical area of origin.

MATERIALS AND METHODS

Date Pit Source and Milling

In order to make an ice cream-type frozen dessert, it is important to use a D.S.S. particle size close to colloidal size in order to provide for proper suspension and to avoid precipitation. In this work, after receiving the date pits (Medjool variety) from the Munson Date Company, Tucson, they were washed with hot tap water to remove sugar material, date material and soil. The date pits were air dried at 40°C for 24 hours and calyx (or cap) removed by hand. Date pits are difficult to grind to small size in an ordinary hammer mill. Therefore, they were sent to Pos Pilot Plant Corporation, Canada, for stud milling into a pulverized pit powder (Fig. 2). After receiving the pulverized date seeds, they were sifted through 40 mesh screen (Table 12).

Duplicate samples were taken for date seed solids (D.S.S.) analysis (Table 12). The analyses include fiber and ether extract (Van Soest 1963), lignion (Ellis, Matrone and Maynard 1946) and crude protein (Kjeldahl) and ash by standard methods.

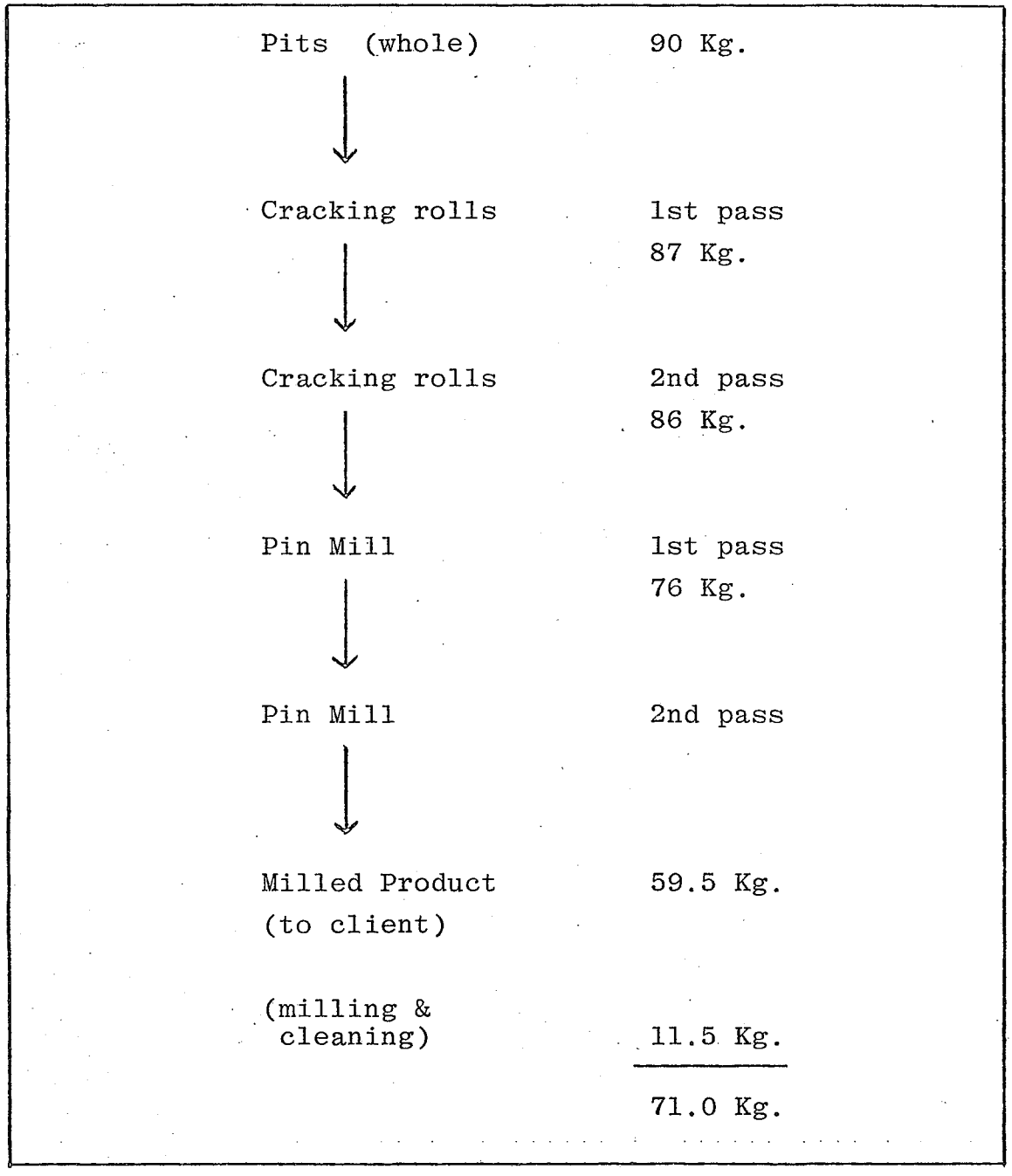

Figure 2. Milling or Pulverizing of Date Pits.

Table 12. Proximate Analysis of Date Seed Solids.

Ingredients	Sample 1	Sample 2	Average
	----------	%	----------
Fiber	70.76	69.77	70.22
Lignin	12.76	11.03	11.85
Ether extract	9.62	9.74	9.63
Kjeldahl (crude protein)	0.29	2.96	1.62
Ash	0.98	1.06	1.02

Frozen Dessert Processing and Freezing

The dry material was combined, slurried in water with a Waring blender, heated to 160°F (71.11°C), the fat was added and melted by mixing. This mixture was homogenized at 3500 p.s.i. Four 8 Kg. batches of each product were formulated using 0, 25, 50 and 100% D.S.S. (Table 13) and using the following formula:

Ingredient	(%)
D.S.S. or M.S.N.F.	11
Sucrose	15
Fat (coconut oil and D.S.S. oil)	10
Cocoa powder	5
Stabilizer/Emulsifier	0.3
Total Solids	41.3

Table 13. Constituents of Chocolate-Flavored Frozen Dessert (gm).

Sample	MSNF	DSS	Sucrose	Coconut Oil	Stabilizer/ Emulsifier	Cocoa	Water
1	880	0	1200	800	24	400	4696
2	660	220	1200	782.4	24	400	4713.6
3	440	660	1200	765	24	400	4731
4	0	880	1200	730	24	400	4766

The formulations involved the use of M.S.N.F. only (Sample 1), combinations of D.S.S. and M.S.N.F. (Samples 2 and 3), or D.S.S. only (Sampel 4). Coconut oil was used in all samples. Since D.S.S. contains at least 8% fat, an adjustment was made in the calculation of the formula to take this into account. The sugar used in dessert was sucrose. It has high solubility and adequate sweetening power. Other kinds of sugar can be used, such as corn syrup or lactose. The stabilizer/emulsifier was a combination of mono-diglycerides, cellulose gum, poly sorbate 80, carragenan, locust gum, guar gum, salt and standardized with dextrose. The purposes of using stabilizer were to produce smoothness in body and texture, reduce ice crystal growth during storage, provide uniformity of product and resistance to melting. Emulsifier was used to produce an

emulsion of two liquids which do not normally mix. Cocoa and vanilla were two flavoring materials used in the frozen dessert. Water was added to provide the needed bulk. To suspend and avoid lumpiness of the dry ingredients, the dry material was mixed with half the total amount of water using a commercial Waring blender, then added to the remaining water, and heated to 120°F. Coconut fat was then added and mixed until it was all melted in preparation for pasteurization.

Pasteurization was important to destroy all pathogenic bacteria. Holding of batch pasteurization was used at 160°F for 30 minutes. Pasteurization is also used to improve flavor, keeping quality and to produce a more uniform product.

The purpose of homogenization was to produce a homogeneous mix and was accomplished at 160°F and 2500 p.s.i. for Sample 1 and 3500 for Samples 2, 3 and 4. A Manton-Gaulin homogenizer (capacity 200 gal/hour), two stage, was used for homogenization. The main purpose of homogenization was to make a permanent and uniform suspension of fat by reducing the size of fat molecules to a very small diameter. The samples were cooled immediately to a temperature of 40°F by using a cold water bath. Cooling the samples was done to increase the viscosity of the mixture.

To age the mixture, it was held for 24 hours in a refrigerator at 33°F. Aging was done to improve the body, texture, and whipping qualities. Twelve ml of vanilla liquid were added to each 8 Kg sample before freezing. The purpose of the freezing was to make small ice crystals and smooth texture. An Emery Thompson Batch freezer (20 gal. capacity) was used to freeze the mixture. The freezer chamber was surrounded by ammonia liquid. The function of the freezing was to freeze a portion of the water of the mix and to incorporate air into the mix. The freezing temperature was at 23°F. The frozen samples were collected in half gallon containers and placed in a hardening room at -20°F. Hardening was important to maintaining uniformity of texture.

Chemical, Physical and Sensory Analysis

Fat and total solids. Fat and total solids were measured by Mojonnier Method using a Mojonnier tester as described by Arbuckle (1977 p. 367).

Overrun and freezing time. Overrun and freezing time were measured during the freezing process (Table 14). The method that was used to calculate the percentage of overrun was by weight of a constant volume (Arbuckle 1977 p. 195):

$$= \frac{\text{(wt. per unit vol. mix)-(wt. per unit vol. ice cream)}}{\text{(wt. per unit vol. of ice cream)}} \times 100$$

Overrun is usually defined as the volume of ice cream obtained in excess of the volume of the mix. This increased volume is causes by air incorporation during the freezing process.

Sensory analysis. Flavor was evaluated immediately after the samples were opened. Flavor was observed by taking one teaspoonful into mouth and keeping it in until the flavor was determined. The body of ice cream pertains to its firmness and resistance. Texture was determined by mouth feel. Texture of ice cream is dependent upon the number, size, shape and arrangement of the ice crystals and other particles (Arbuckle 1977, p. 323).

RESULTS AND DISCUSSION

Abusida (1979) used various preliminary treatments to soften date pits. For example, he soaked the pits in either NaoH or $NaHCo_3$, or used dilute solutions of hydrochloric or sulfuric acids. This treatment was not effective in softening the date pits but autoclaving had slight effect.

In this work, the pits were pulverized by stud (pin) milling and sifting the small particles by using different sieve sizes. This gave an acceptable result. The final particle size was 40 mesh, which assisted in keeping the particles in suspension. Four experimental frozen desserts were made from the milled date seed solids (D.S.S.). Sample 1 was the control, which contained M.S.N.F. and D.S.S. (Table 12). Ingredients of each sample were mixed, pasteurized, homogenized, cooled and refrigerated in plastic containers for aging.

After aging, Sample 2 had the highest viscosity of all samples. It had a slightly coarse texture with no apparent separation of liquid during 24 hr. storage at $4^{o}C$. Sample 3 had less viscosity than Sample 2, being similar to the control but higher than Sample 4. It had

a definite coarse texture, plastic body and some liquid separation during storage. Sample 4 had lower viscosity than Samples 2 and 3, but more than the control. It had a pronounced coarse texture and slight plastic body. It had considerable liquid separation.

The high viscosity was possibly due to the presence of pectin or its derivatives in the D.S.S. which gave a hydrophilic effect. The high viscosity could be controlled by using less added stabilizer. Liquid separation might be caused by high viscosity or by the cooling method.

All samples were frozen and kept in a hardening room at -35°F. Overrun, freezing times, total solids and fat content were measured (Table 14). Dessert composition was within expected values.

Table 14. Frozen Dessert Analysis.

Sample	Fat (%)	Total Solids (%)	Overrun (%)	Freezing Time (minutes)
1 (control)	11.0	41.2	33.7	8
2	9.5	41.2	38.7	7
3	9.2	41.35	28.6	6
4	9.8	41.40	24.4	4

Sensory evaluation data showed that Sample 1 had a slightly salty taste. This might have been due to the type and amount of cocoa powder used or to other non-fat ingredients. No other problems were observed. Samples 2 and 3 with 25 and 50% D.S.S., respectively, showed the same sensory properties as the control but they had a slightly coarse texture. The coarse texture intensity in Sample 2 was felt to be acceptable. Sample 4, with 100% D.S.S., showed a pronounced coarse texture, hard body, different color and taste. It was the least acceptable. Coarse texture was due to the D.S.S. particles. It could be controlled by decreasing the particle size from 50 m to 25 m.

No microbiological testing was made on the final products. Pasteurization at 160^{o}F for 30 minutes was enough to kill all pathogenic and spoilage organisms. Other sources of protein, such as vegetable protein isolate, together with other fats, sugar, and flavor could be used in this type of frozen dessert. Comfinations of autoclaving and enzymatic proteolysis might aid in softening the D.S.S.

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