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# Preparation and Protein-Fortification of Date Bars

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TO INCREASE the utilization and the nutritional value of the fruits of Hayani date cultivar; the most dominant among date cultivars grown in the north eastern sector of Egypt, the fruits were minced, dried and formulated into date bars. Also, the prepared bars were fortified using casein, skim milk powder, sesame, soybean and chickpea flours (3, 5, 7 and 10% of total weight). The prepared date bars were evaluated for colour, texture, yield and protein content. Sensory properties of the products were also evaluated and compared to the unfortified plain bars. In addition, the proximate composition, the mineral content and the amino acids profile of the fortified (5%) bars were carried out. Data obtained indicated that the prepared plain date bars and the bars fortified to 5% level were organoleptically acceptable. Meanwhile, coating the bars fortified with higher levels (7-10%) of the additives with chocolate increased the overall acceptability of the product. The data also revealed that fortification, as expected increased the protein content (from 3.5 to 12.2%) while slight changes in texture and colour of the fortified product were noted. In addition, proximate composition varied according to the fortification source. Total and reducing sugars and crude fibers were slightly decreased, while the ash content was relatively increased. All amino acids including the essential ones were considerably increased in the fortified bars with casein or skim milk powder. These findings indicate that the Hayani dates can be processed into acceptable date bars with improved nutritional profile by fortification using casein, skim milk, soybean or chickpea flour. The application of this process may increase the utilization of Hayani date fruits, which have low eating quality in the fresh unprocessed form, and provide the consumer with date products of high nutritional value.

Date (*Phoenix datylifera* L.) is one of the major fruit crops grown in Egypt, with an annual total production of 1,006,714 tons (Ministry of Agriculture, 2001). However, only a small amount of date produced is dried (mostly sun-drying using simple platform on the ground and flat-roof tops on the open air, (Ampratwum, 1998), or processed into paste (by grinding and molding the dried dates), Jam and date syrup known as dibs (Mohammad & Ahmad, 1981 and El-Shaarawy *et al.*, 1989). Dates are considered rich in calories with 80% carbohydrates and relatively low protein content of about 3% (Ahmed *et al.*,

1995). One approach for the improvement of their nutritional quality could be to supplement them with inexpensive high protein ingredients. Recently, Al-Hooti *et al.* (1997) reported the preparation of fortified date bars containing skim milk powder, almonds, oat flakes or sesame seeds. The average ash, fat and protein contents in the control date bar samples were 1.78, 6.09, and 7.83%, respectively, but supplementation with skim milk powder resulted in increased protein and ash contents, but the fat content was slightly decreased. In Saudi Arabia, Sawaya *et al.* (1983) and Yousif (1994) evaluated plain fortified and chocolate coated date bars. The fortified date bars were formulated from date paste, soy protein isolate, skim milk, almonds, coconut, corn starch, ground nuts and pistachio nuts at various levels. Coating the bars with chocolate reduced the adverse effects noticed for plain bars during storage. In Egypt, Shehata (1992) found that supplemented pastry products containing date bars with 6% fish protein concentrate gave the highest weight gain and highest protein efficiency ratio as compared to other pastry products. Other studies on date bars were also reported (Shinwari, 1993).

This work aimed to study the possibility of processing the second quality date fruits by increasing the nutritional profile of the prepared date bars through supplementation with casein, skim milk powder, sesame seed, chickpea and soybean flours.

## Material and Methods

*Materials*

Date fruits used in the preparation of the plain date paste were from hayani variety which is the most cultivated variety in Ismailia governorate and is not used as a table fruit. The fruits were collected in the rutab stage from a private farm in Ismailia governorate.

Chickpeas (Humus El-Sham) and sesame seeds were purchased from local market, while casein, skim milk powder and soybean flour were originally imported from Holland. Food grade citric acid, ascorbic acid, cocoa powder, chocolate and coconut were also used in the formulation.

The chickpeas were pretreated by soaking in water (1:3, seed: water) at room temperature (25°C) for 24 hr. Soaking water was changed after 12 hr and drained at the end of soaking period. The soaked seeds were then cooked in water (1:5, seeds : water) at 100°C for 30 min. The cooked seeds were dried at 70°C for 12hr then ground into chickpea flour, to pass through 0.5 mm sieve.

*Preparation of date paste and date bars*

Date fruits at rutab stage of ripening were sorted to remove extraneous matters, then the fruits were peeled and the flesh was stored at -18°C until using for paste preparation. Freezing is not necessary if the fruit flesh is directly processed (dried) without the need for storage. The frozen flesh (pulp) was

thawed and pasteurized in a microwave oven to an internal temperature of 80°C for 2 min, then the pulp was spread on trays (2 cm thick) and dried at 50°C for 24 hr. The dried pulp was mixed with casein, skim milk powder, sesame, chickpea, or soybean flours at 0, 3, 5, 7 and 10% of the total weight, and shaped into bars (1 x 2 x 8 cm). Citric acid (0.05%) and ascorbic acid (0.05%) were included in all formulations. Cocoa powder was added to some formulations prepared by the addition of high levels (7 and 10%) of protein sources in order to increase the palatability of the resulted date bars.

*Physical and chemical evaluation of date bars*

The plain and fortified date bars were evaluated for yield, colour (L, a and b values) and texture (tenderometer measurements). Proximate composition of the date bars, including protein, fat, crude fibers, ash, reducing and total sugars, was estimated according to the methods of the AOAC (1995), while amino acids contents were determined using a Biochrom 20 amino acid analyzer (Pharmacia Biotech) as described by Blackburn (1968). Zinc, copper, iron, magnesium, manganese and calcium contents were estimated using a Perkin-Elmer (3030 model) Atomic Absorption Spectrophotometer as described by Ahmed *et al.* (1995). The sensory properties of the date products were evaluated on a hedonic scale according to Kramer and Twigg (1974). The data were statistically analyzed for ANOVA and Duncan's LSD to locate the differences among means using general linear model procedure of the statistical Analysis System (SAS, 1988).

## Results and Discussion

*Yield*

The yield of plain date bars (Table 1) calculated as the percentage of product to total ingredients was 44.95%. The fortification with casein skim milk powder, sesame, soybean and chickpea flours increased the yield of the fortified date bars proportional to the amount added. The increment ranged from about 3 to 9% depending on the type and percentage of additives. This is probably due to the high total solids (Table 2) in the added materials as compared to that of date paste.

The protein content of the plain date bars was 3.51% (Table 1). Addition of casein or skim milk powder, soybean and chickpea flour as well as sesame to the plain date paste increased the protein content of the date bars. The highest content (12.2%) was noted when 10% casein was included, while comparable low protein levels was indicated with the inclusion of sesame or chickpea flours. The variation in the protein content in the fortified date bars is attributed to the differences in the protein content as shown in Table 2 of the added ingredients, with casein having the highest content (87.16%), while sesame showed the least (21.24%) followed by chickpea (26.92%).

**TABLE 1. Yield, protein, texture and colour of date products (date bars) containing skim milk, casein, soy flour, chickpea flour and sesame.**

| Treatment | | Yield (%) | Protein (%) | Texture | Colour | | |
|---|---|---|---|---|---|---|---|
| | | | | | L | a | b |
| Control | | 44.95 ± 2.8 | 3.51 ± 0.2 | 5.2 ± 0.2 | 45.2 | + 9.1 | + 11.7 |
| Casein | 3% | 47.70 ± 2.0 | 6.20 ± 0.3 | 3.1 ± 0.1 | 41.4 | + 10.0 | + 14.0 |
| | 5% | 48.0 ± 2.0 | 7.91 ± 0.3 | 5.3 ± 0.2 | 41.0 | + 10.0 | + 14.6 |
| | 7% | 50.6 ± 2.0 | 9.49 ± 0.4 | 5.8 ± 0.2 | 39.1 | + 11.0 | + 10.6 |
| | 10% | 51.30 ± 2.1 | 12.20 ± 0.4 | 6.0 ± 0.3 | 37.4 | + 11.9 | + 11.5 |
| Soy flour | 3% | 49.70 ± 1.5 | 5.10 ± 0.1 | 3.5 ± 0.1 | 36.4 | + 8.6 | + 10.6 |
| | 5% | 50.90 ± 2.0 | 6.01 ± 0.2 | 5.2 ± 0.2 | 37.4 | + 9.0 | + 11.4 |
| | 7% | 53.80 ± 2.1 | 7.09 ± 0.2 | 5.6 ± 0.2 | 36.9 | + 7.7 | + 7.2 |
| | 10% | 56.20 ± 2.0 | 8.60 ± 0.3 | 5.8 ± 0.3 | 34.5 | + 9.0 | + 7.5 |
| Skim milk | 3% | 45.59 ± 1.5 | 4.60 ± 0.1 | 2.4 ± 0.1 | 36.8 | + 6.3 | + 8.5 |
| | 5% | 49.12 ± 1.6 | 5.25 ± 0.1 | 0.5 ± 0.1 | 37.4 | + 6.8 | +7.8 |
| | 7% | 51.62 ± 2.0 | 6.05 ± 0.2 | 0.7 ± 0.1 | 38.5 | + 7.3 | +8.9 |
| | 10% | 51.71 ± 1.8 | 7.30 ± 0.2 | 1.2 ± 0.1 | 38.6 | + 7.7 | +10.6 |
| Chickpea | 3% | 49.30 ± 1.6 | 4.35 ± 0.1 | 2.9 ± 0.1 | 36.4 | + 8.9 | +11.9 |
| | 5% | 52.80 ± 1.8 | 4.91 ± 0.1 | 3.3 ± 0.2 | 40.1 | + 6.6 | +8.6 |
| | 7% | 53.20 ± 2.0 | 5.42 ± 0.1 | 7.6 ± 0.2 | 41.1 | + 6.9 | +5.5 |
| | 10% | 54.70 ± 1.9 | 6.22 ± 0.2 | 8.0 ± 0.3 | 42.2 | + 9.2 | +6.9 |
| Sesame | 3% | 47.10 ± 1.6 | 4.13 ± 0.1 | 1.5 ± 0.1 | 36.6 | + 6.9 | +8.0 |
| | 5% | 48.10 ± 1.7 | 4.60 ± 0.1 | 1.3 ± 0.1 | 41.3 | + 5.9 | +6.2 |
| | 7% | 49.20 ± 1.8 | 5.10 ± 0.1 | 1.1 ± 0.1 | 38.8 | + 5.8 | +5.2 |
| | 10% | 52.50 ± 2.0 | 5.60 ± 0.2 | 1.0 ± 0.1 | 36.8 | + 4.7 | + 4.4 |

Data are expressed as means of three replicates except color date which are means of 10 measurements for each replicates.

**TABLE 2. Moisture and protein contents of protein sources used in the preparation of date bars .**

| Constituent | Moisture (%) | Protein (%) |
|---|---|---|
| Casein | 3.97 ± 0.15 | 87.16 ± 3.5 |
| Skim milk powder | 3.31 ± 0.15 | 37.05 ± 1.2 |
| Soy flour | 4.43 ± 0.20 | 51.01 ± 2.0 |
| Chickpea flour | 1.80 ± 0.10 | 26.92 ± 1.1 |
| Sesame seeds | 2.87 ± 0.12 | 21.27 ± 1.0 |

Data are expressed as means of three replicates ± standard deviation .

*Texture*

The texture of any food item is an important quality attribute. The obtained data (Table 1) indicated that texture of the prepared date bars varied according to the kind and amount of added ingredients. The tenderometer reading of the plain bars was 5.2 kg/cm$^2$. Fortification at 3% level reduced the texture readings for all studied substances. At 5% level no appreciable changes were found with casein and soybean flour. However, at 7 and 10% levels of inclusion of casein, soybean and chickpea flours, higher texture readings were recorded. Skim milk powder and sesame gave soft date bars at all studied levels. This is probably due to the type and level of constituents in each added material, especially the hydrocolloids and collided systems established in the tested date bars. The high lactose content in the skim milk powder and oil in the sesame would have a great effect on the texture of the tested bars.

*Colour*

As shown in Table 1 the lightness (L) value of date bars was decreased with the inclusion of all additives. This means that additives produced somewhat darker bars than the control or plain bars. This could be attributed to the non-enzymatic (Millard) browning reaction. The redness of the products (a value at the positive side) was slightly increased for casein-containing bars. However, noticeable lower values with sesame and chickpea addition were observed.

With regard to yellowness (b value at the positive side), noticeable decrease was observed, especially at the higher levels (7-10%) of soy flour and chickpea flour or even at low levels of sesame.

*Sensory evaluation*

The sensory properties of plain and fortified as well as Cocoa containing (0.5%) date bars are shown in Table 3. Colour, odour, taste, appearance, mouth feel and texture of the prepared bars significantly varied according to the type and percentage of used additives. Colour score of the fortified bars was increased with increasing the additives proportion. The addition of Cocoa powder to the formulations containing casein, soybean flour, sesame or chickpea flour at 7 and 10% levels did not enhance the sensory scores (Table 4). Coating the fortified bars with chocolate greatly enhanced the sensory scores of the bars especially at the higher level of fortification. Therefore, no significant variations were noticed between the levels of addition resulting in acceptable fortified bars at all levels used for fortification.

*Proximate composition*

The contents of protein, fat, crude fibers, ash, reducing and total sugars in date bars fortified with 5% of the protein source ingredients are shown in Table 5. The protein content, as indicated earlier in this work, of the fortified bars was increased. Casein addition resulted in the highest protein content (7.91%), while sesame gave the lowest (4.61%). Total sugars amounted to 62.2-66.5% of the total solids of fortified date bars as compared to 58.7% of the plain bars. The

**TABLE 3. Sensory evaluation of date bars containing skim milk, casein, soy flour, chickpea flour and sesame .**

| Treatment | | Colour (10) | Odour (10) | Taste (10) | Appearance (10) | Texture (10) | Overall acceptability |
|---|---|---|---|---|---|---|---|
| Control | | 6.00 c | 6.13 a | 6.88a | 6.25 c | 5.75 c | 31.00 b |
| Skim milk | 3% | 6.88 b,c | 7.13a | 7.88a | 7.13 a, b, c | 8.13 a | 37.13 a |
| | 5% | 7.13 b | 6.88a | 7.63a | 6.75 b, c | 7.50a , b | 35.88 a |
| | 7% | 8.00 a,b | 6.88a | 7.50a | 7.63 a, b | 6.88 b | 36.88 a |
| | 10% | 8.38 a | 6.88a | 7.50a | 8.13 a | 7.00 b | 37.63 a |
| Control | | 6.00 c | 6.13 a, b, c | 6.88 a, b | 6.25 b, c | 5.75 b, c | 31.00 c |
| Casein | 3% | 8.13 a | 7.38 a | 7.25 a | 8.25 a | 7.50 a | 37.25 a, b |
| | 5% | 8.38 a | 7.00 a, b | 7.38 a | 8.63 a | 7.75 a | 39.13 a |
| | 7%+ 0.5% Co | 7.38 a, b | 5.63 b, c | 5.63 b | 7.38 a, b | 6.50 a, b | 32.50 b,c |
| | 10%+ 0.5% Co | 6.50 b, c | 4.88 c | 4.00 c | 5.00 c | 4.75 c | 24.88 d |
| Control | | 6.00 b | 6.13 a | 6.88 a, b | 6.25a | 5.75 a | 31.00 b,c |
| Soy flour | 3% | 7.75 a | 6.75 a | 7.25 a | 7.50a | 6.88a | 36.25 a |
| | 5% | 8.25 a | 6.50 a | 6.38 a, b | 8.00a | 6.38a | 34.38 a,b |
| | 7%+ 0.5% Co | 7.00 a, b | 5.38 a | 5.63 b, c | 6.75a | 5.88a | 30.63 b,c |
| | 10%+ 0.5% Co | 6.25 b | 4.00 b | 4.75 c | 6.25a | 5.88a | 26.75 c |
| Control | | 6.00 d | 6.13 a, b | 6.88 a | 6.25 b | 5.75a | 31.00 b |
| Sesame | 3% | 8.00 a, b | 7.00 a | 6.13 a | 7.88 a | 6.63a | 35.63 a |
| | 5% | 8.50 a | 6.75 a | 6.00 a | 7.88 a | 6.63a | 35.75 a |
| | 7%+ 0.5% Co | 7.13 b, c | 5.00 b, c | 5.38 a,b | 6.88 b | 5.75a | 30.13 b |
| | 10%+ 0.5% Co | 6.38 c,d | 4.50 c | 4.13 b | 6.50 b | 5.50a | 27.00 b |
| Control | | 6.00 c | 6.13 a, b | 6.88 a, b | 6.25 c | 5.75 b, c | 31.00 b |
| Chickpea | 3% | 7.63 a,b | 7.25 a | 7.25 a | 7.63 a, b | 6.75 a | 36.50 a |
| | 5% | 8.13 a | 6.63 a, b | 6.63 a, b | 7.88 a | 7.00 a | 36.25 a |
| | 7%+ 0.5% Co | 6.75 b,c | 5.50 b, c | 5.75 b, c | 6.75 b, c | 6.38 a, b | 31.13 b |
| | 10%+ 0.5% Co | 1.21 c | 4.75 c | 5.13 c | 5.13 d | 5.25 c | 26.00 c |

Co =Cocoa powder, Means within the same column with different letters are significantly different at p=0.05.

TABLE 4. Sensory evaluation of chocolate coated date bars containing skim milk, casein, soy flour, chickpea flour and sesame .

| Treatment | | Color (10) | Odor (10) | Taste (10) | Appearance | Mouthfeel & texture (10) | Overall acceptability |
|---|---|---|---|---|---|---|---|
| Casein | 3% | 8.86 a | 8.71 | 8.86 a | 9.00 a | 8.71 a | 44.14 a |
| | 5% | 8.86 a | 8.57 | 8.29 a, b | 9.00 a | 8.57 a | 43.29 a |
| | 7% + 0.5%Co | 8.43 a, b | 8.43 | 7.00 c | 8.29 b | 7.43 b | 39.57 b |
| | 10% + 0.5%Co | 8.14 b | 8.00 | 7.57 b, c | 8.00 b | 7.14 b | 38.86 b |
| | LSD (p=0.05) | 0.56 | Ns | 0.84 | 0.54 | 2.24 | |
| Soy flour | 3% | 8.57 | 8.29 | 7.43 | 8.43 | 7.86 | 40.57 |
| | 5% | 8.57 | 8.14 | 7.86 | 8.57 | 7.71 | 40.86 |
| | 7%+ 0.5% Co | 8.29 | 8.00 | 7.57 | 8.57 | 7.71 | 40.14 |
| | 10%+ 0.5% Co | 8.00 | 8.14 | 7.29 | 7.86 | 7.71 | 39.00 |
| | LSD (p=0.05) | NS | NS | NS | NS | NS | |
| Skim milk | 3% | 8.14 | 8.29 | 8.29 | 9.00 | 8.86 | 42.57 |
| | 5% | 8.14 | 8.29 | 8.71 | 8.71 | 8.43 | 42.29 |
| | 7% | 8.00 | 8.29 | 8.57 | 8.71 | 8.43 | 42.14 |
| | 10% | 7.86 | 8.29 | 8.57 | 8.57 | 7.71 | 40.86 |
| | LSD (p=0.05) | NS | NS | NS | NS | NS | |
| Chickpea | 3% | 9.00 | 8.71 | 7.86 | 8.86 | 7.71 | 42.14 |
| | 5% | 8.86 | 8.71 | 7.14 | 8.43 | 6.86 | 40.14 |
| | 7%+ 0.5% Co | 8.43 | 8.57 | 7.57 | 7.86 | 7.00 | 39.43 |
| | 10%+ 0.5% Co | 8.14 | 8.57 | 6.86 | 7.86 | 6.71 | 38.14 |
| | LSD (p=0.05) | | NS | NS | NS | NS | |
| Sesame | 3% | 8.57 | 8.14 | 7.57 | 8.57 | 8.14 | 41.00 |
| | 5% | 8.29 | 8.00 | 6.71 | 7.71 | 6.29 | 37.00 |
| | 7%+ 0.5% Co | 8.00 | 8.00 | 7.29 | 8.57 | 7.57 | 39.43 |
| | 10%+ 0.5% Co | 7.86 | 8.14 | 7.29 | 8.43 | 7.29 | 39.14 |
| | LSD (p=0.05) | NS | NS | NS | NS | NS | |

Co =Cocoa powder, Means within the same column having the same letter are not significantly different at p =0.05.

data also indicated that most of the sugars were in the reducing form. These results are in agreement with those of Ahmed *et al.* (1995) and El-Feky (2002). The results also revealed that fortification slightly affected fat and crude fiber contents. Crude fat ranged from 2.38 to 3.32%, except samples fortified with sesame or coated with chocolate which showed a relatively higher values (about 5%). The crud fiber ranged from 2.51 to 3.17. However, the ash content of the prepared bars varied according to the fortification constituent. Fortified bars with skim milk powder coated with chocolate showed the highest ash content (2.9%), followed by those fortified with soybean flour while casein did not affect ash content in comparison with the plain bars (2.04%). Similar conclusion was reported by Sawaya *et al.* (1983) for date bars fortified with soy protein isolate and dry skim milk.

**TABLE 5. Proximate composition of date paste products containing skim milk powder, casein, sesame, soybean and chickpea flours.**

| Treatments | Protein % (N x 6.25) | Reducing sugars % | Total sugars % | Crude fat % | Crude fiber % | Ash % |
|---|---|---|---|---|---|---|
| Control | 3.40 ± 0.02 | 40.5 ± 0.80 | 68.7 ± 0.4 | 3.32 ± 0.3 | 3.15 ± 0.03 | 2.04 ± 0.02 |
| Skim milk 5% | 5.25 ± 0.05 | 41.5 ± 0.3 | 65.7 ± 0.4 | 3.00 ± 0.2 | 2.43 ± 0.03 | 2.59 ± 0.04 |
| Casein 5% | 7.91 ± 0.21 | 38.5 ± 0.3 | 62.6 ± 0.6 | 2.82 ± 0.4 | 2.48 ± 0.03 | 1.92 ± 0.02 |
| Soybean 5% | 6.1 ± 0.20 | 40.3 ± 0.7 | 63.5 ± 0.7 | 2.66 ± 0.02 | 3.12 ± 0.03 | 2.65 ± 0.03 |
| Chickpea 5% | 4.91 ± 0.19 | 40.7 ± 0.6 | 62.2 ± 0.3 | 2.38 ± 0.04 | 2.92 ± 0.03 | 2.19 ± 0.02 |
| Sesame 5% | 4.60 ± 0.14 | 40.2 ± 0.7 | 62.5 ± 0.4 | 4.82 ± 0.04 | 3.17 ± 0.04 | 2.26 ± 0.03 |
| Skim milk 5% + chocolate coat | 6.0 ± 0.22 | 42.0 ± 0.4 | 66.5 ± 0.6 | 5.00 ± 0.05 | 2.51 ± 0.02 | 2.90 ± 0.05 |

Data are expressed as means of three replicates ± standard deviation (dry weight basis).

*Minerals*

Data presented in Table 6 showed that plain date bars contained 0.33, 0.41, 4.91, 9.38, 45.6 and 167.4 mg/100 g of Cu, Mn, Zn, Fe, Ca and Mg, respectively. These data agree with those of Yousif *et al.* (1982) for Iraqui dates and Anwar-Shinawari (1987) for Saudi Arabian dates. The authors confirmed that dates are a rich source for iron. However, Ahmed *et al.* (1995) reported lower values for Emirate dates (12 varieties at rutab stage). On the other hand, Abdel Hady *et al.* (2002) mentioned that the addition of each of Egyptian date pulp and/or concentrate increased the most minerals content of the rice-based extrudates.

**TABLE 6. Mineral composition (mg/100 g, dry weight basis) of the date bars.**

| Treatments | Cu | Mn | Zn | Fe | Ca | Mg |
|---|---|---|---|---|---|---|
| Control (plain bars) | 0.33 ± 0.02 | 0.41 ±0.03 | 4.91 ±0.10 | 9.38 ±0.20 | 45.6 ±1.2 | 167 ±2.5 |
| Skim milk (SM) | 0.35 ±0.02 | 0.50 ±0.03 | 3.00 ±0.05 | 4.20 ±0.10 | 96.7 ±2.1 | 232 ±2.2 |
| Soybean | 0.51 ±0.03 | 1.04 ±0.02 | 2.42 ±0.06 | 3.62 ±0.07 | 51.6 ±1.5 | 285 ±2.6 |
| Sesame | 0.71 ±0.02 | 1.12 ±0.03 | 4.31 ±0.08 | 5.27 ±0.08 | 81.5 ±1.6 | 346 ±2.8 |
| Chickpea flour | 0.28 ±0.01 | 0.75 ±0.02 | 7.26 ±0.10 | 4.59 ±0.06 | 56.3 ±1.1 | 174 ±2.1 |
| Casein | 0.34 ±0.02 | 0.41 ±0.02 | 14.5 ±0.15 | 3.42 ±0.05 | 53.4 ±1.2 | 253 ±2.3 |
| SM + Chocolate coat | 0.36 ±0.02 | 0.43 ±0.03 | 3.32 ±0.05 | 6.53 ±0.10 | 122.3 ±2.2 | 270 ±2.5 |

Data are expressed as means of three replicates ± standard deviation (dry weight basis).

Fortification of the date bars with the protein rich ingredients (at 5% level of addition) greatly affected the mineral content of the date products. Soybean flour increased Cu, Mg, Mn, and Ca contents, while it caused a reduction in Zn and Fe contents. Similar results are shown for skim milk powder which greatly increased the product calcium content. The data also indicated that chickpea flour and casein increased the zinc content of the fortified date bars. The human daily requirements of mineral has been estimated by Robinson (1972), for iron 10 mg, manganese 4 mg, copper 1-2 mg and zinc 15 mg, it can be concluded that date bars contain relatively high amounts of manganese, calcium and iron. Fortification further increased the mineral contents of most of the tested elements. Sawaya *et al.* (1983) stated that fortification of plain and chocolate coated date bars made from Ruzeiz Saudi dates, with soy protein isolate and dry skim milk resulted in an increase in ash, Na, K, Ca, Mg, P and Zn.

*Amino acids*

The amino acids profiles of plain and fortified date bars with 5% of casein or skim milk, sesame, soybean or chickpea flours are given in Table 7. Comparisons among samples showed differences in most of the amino acids (A.A) including essential amino acids. Fortification of date bars greatly increased the levels of all measured amino acids as compared to those corresponding acids in the plain sample. Variations were also noticed among the fortified samples. These differences were due to the kind of additives as well as to the concentration and the quality of protein in these additives. The highest level of the analyzed amino

acids was noticed in the sample fortified with casein, followed by that containing skim milk powder or soybean flour. The data also showed that 100 g of date bar containing casein would provide man with about one-third of his daily requirements of the essential amino acids lysine and phenylalanine, 50% of that of valine, threonine and leucine + isoleucine). However, methionine level was still relatively low. Also, sesame inclusion, though increased the levels of all amino acids in comparison to plain bars, it showed the least A.A increment among the other added substances. These results are in agreement with those obtained by Salem and Hegazi (1971), Auda *et al.* (1976) and Ahmed *et al.* (1995) who believed that dates can contribute an additional source of protein to the human diet with high quality of some essential amino acids. Sawaya *et al.* (1983) added that fortification of plain date bars with soy protein isolate and dry skim milk increased all the essential amino acids and improved the chemical score from 48 to 83.95.

**TABLE 7. Amino acid analysis (mg/100g) of date bars containing skim milk powder, soybean flour, sesame, chickpea flour and casein .**

| Amino acid | Treatments | | | | | | | Daily requirements of man (mg)* |
|---|---|---|---|---|---|---|---|---|
| | Control | Skim milk powder, 5% | Soybean flour, 5% | Sesame, 5% | Chickpea flour, 5% | Casein, 5% | Skim milk powder + chocolate coating | |
| Essential | | | | | | | | |
| Isoleusine | 40 | 192 | 190 | 130 | 80 | 308 | 210 | - |
| Leusine | 90 | 416 | 390 | 280 | 170 | 672 | 470 | 1800 (Leu+Ile) |
| Lysine | 50 | 192 | 160 | 100 | 80 | 308 | 200 | 800 |
| Methionine | 10 | 40 | 40 | 40 | 20 | 84 | 090 | 1100 |
| Phenylalanine | 60 | 232 | 250 | 180 | 120 | 364 | 250 | 1100 |
| Threonine | 40 | 200 | 210 | 150 | 80 | 322 | 220 | 500 |
| Valine | 80 | 264 | 230 | 184 | 110 | 434 | 290 | 800 |
| Tryptophan | - | - | - | - | - | - | - | 250 |
| Histidine | 20 | 88 | 100 | 80 | 40 | 154 | 100 | - |
| Non-essential | | | | | | | | |
| Alanine | 80 | 208 | 250 | 220 | 130 | 266 | 210 | - |
| Arginine | 60 | 160 | 290 | 370 | 150 | 224 | 184 | - |
| Aspartic acid | 380 | 672 | 850 | 840 | 450 | 826 | 63 | - |
| Cystine | 30 | 40 | 50 | 50 | 30 | 42 | 40 | - |
| Glutamic acid | 220 | 736 | 990 | 790 | 400 | 1722 | 120 | - |
| Glycine | 90 | 176 | 250 | 250 | 120 | 196 | 150 | - |
| Proline | 140 | 408 | 330 | 270 | 160 | 798 | 520 | - |
| Serine | 60 | 272 | 280 | 210 | 120 | 434 | 290 | - |
| Tyrosine | 10 | 88 | 90 | 90 | 20 | 154 | 150 | - |

In conclusion, based on the results of this study, it can be stated that an acceptable date bars can be produced from Hayani (soft) dates, and the protein quantity and quality of these bars can be enhanced without any deleterious effect on acceptability.

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# إعداد وتدعيم أعمدة التمر بالبروتين

صلاح كامل السماحى ، رمضان احمد حبيبة و آمال عبد الفتاح جاب الله
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لزيادة الاستفادة ورفع القيمة الغذائية لثمار البلح "صنف الحيانى" الذى يزرع بكثرة فى شمال شرق مصر تم دراسة إمكانية تصنيع الثمار بفرمها وتجفيفها وتشكيلها فى صورة قطع على شكل أعمدة "Bar" كما تم أيضا تدعيم المنتج بإضافة مصادر غنية بالبروتين (كازين ، لبن مجفف منزوع الدهن ، دقيق فول الصويا ، دقيق حمص الشام والسمسم) بنسبة ٣ ، ٥ ، ٧ ، ١٠% . وتم تقييم المنتجات من حيث القوام واللون والناتج yield والنسبة المئوية للبروتين. كذلك تم إجراء تقييم حسى للقطع المدعمة مقارنة بغير المدعمة. كما تم تقدير التركيب الكيماوى بما فى ذلك النسبة المئوية للأحماض الأمينية ومحتواها من بعض العناصر المعدنية الهامة مثل الزنك والحديد والنحاس والماغنسيوم والمنجنيز والكالسيوم.

أوضحت النتائج ان قطع التمر المنتجة مقبولة حسيا وان المنتج المدعم حتى نسبة ٥% بالوزن مقبول أيضا بواسطة المحكمين وان نسبة التدعيم يمكن زيادتها إلى ١٠% بشرط تغطية الناتج بطبقة من الشيكولاته.

وقد أدى التدعيم بالمصادر الغنية بالبروتين إلى زيادة نسبة البروتين فى المنتج (من ٣,٥% إلى ١٢,٢ %)، بينما حدثت تغيرات قليلة فى اللون والقوام تبعا لمصدر التدعيم ونسبة الإضافة. كما أدى التدعيم (بنسبة ٥%) إلى زيادة واضحة فى مستوى جميع الأحماض الأمينية بما فى ذلك الأحماض الأمينية الأساسية بالمقارنة بمستواها فى الناتج غير المدعم ، وقد لوحظ أعلى مستوى لها فى العينات المدعمة بالكازين يليها المدعمة باللبن المجفف ثم المدعم بدقيق فول الصويا مع ملاحظة أن الميثايونين ظل منخفض نسبيا ، كما حدثت زيادة فى نسبة الرماد الكلى وفى معظم العناصر المعدنية (ما عدا الحديد) نتيجة للتدعيم. بينما حدث انخفاض طفيف فى السكريات الكلية و المختزلة والألياف الخام.

مما سبق يتبين انه يمكن إنتاج منتج أعمدة التمر Date Bars وتحسين قيمتها الغذائية من حيث نسبة البروتين والأحماض الأمينية والعناصر المعدنية بتدعيمها بمصادر غنية فى البروتين مثل الكازين ، اللبن المجفف منزوع الدهن ، دقيق فول الصويا ودقيق حمص الشام ، وتطبيق نتائج هذا البحث يمكن أن تزيد من الاستفادة من ثمار بلح الحيانى (وربما غيره من الأصناف الرطبة ذات الصفات الأكلية غير الممتازة فى الصورة غير المصنعة والمنتشر زراعتها فى مصر) كما يؤدى المنتج المدعم الى حصول المستهلك على قيمة غذائية افضل.