**Food and Nutrition Sciences, 2016, 7, 533-543**
Published Online June 2016 in SciRes. http://www.scirp.org/journal/fns
http://dx.doi.org/10.4236/fns.2016.77055

# Development of Novel Confectionary Bars by Utilizing Date "Tagyat Variety"

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Received 12 May 2016; accepted 11 June 2016; published 15 June 2016



## Abstract

**In present study, we aimed at producing novel date-based bars (DBs) by using "Tagyat variety". The materials used were date "Tagyat", Dried mill, peeled white sesame seeds, peeled peanut, grated coconut, cacao powder and corn starch. The raw materials and produced DBs were chemically analyzed. The energy values for DBs were calculated. Minerals and amino acids were determined for all produced DBs. The DBs were organoleptically evaluated. Tagyat date had the higher moisture, total, reducing and non-reducing sugars contents (22.23%, 66.81%, 53.55% and 12.60%, respectively). Dried milk, peanut and peeled white sesame had the higher crude protein content being 31.94%, 28.59% and 23.99%, respectively. Peeled white sesame seeds, peeled peanuts and grated coconuts had the highest amount of crude fat being 54.35%, 52.21% and 49.93%, respectively. Dried milk and cacao powder had higher total ash content which contained 5.25% and 5.23%, respectively. The moisture content of BDs was in range of 16.16% to 17.49%. The crude protein content of the six BDs varied from 9.16% to 12.35%. Crude fat of BDs ranged from 10.13% to 11.75%. Ash content of BDs ranged from 2.39% to 2.78%. The reducing and non-reducing sugar content of BDs varied from 46.32% to 48.07% and 41.14% to 43.08%. The energy values of BDs ranged from 372.28 to 382.87 K cal·100 $g^{-1}$. Novel $DB_s$ contain appreciable amounts of K (ranged from 621.94 to 719.85 mg·100 $g^{-1}$), P (ranged from 92.53 to 113.83 mg·100 $g^{-1}$), Ca (ranged from 59.77 to 69.48 mg·100 $g^{-1}$), Mg (ranged from 37.69 to 43.81 mg·100 $g^{-1}$), Na (ranged from 28.41 to 35.48 mg·100 $g^{-1}$), Fe (ranged from 3.29 to 5.14 mg·100 $g^{-1}$) , Zn (ranged from 3.10 to 3.60 mg·100 $g^{-1}$), Cu (ranged from 1.21 to 1.40 mg·100 $g^{-1}$) and Mn (ranged from 0.95 to 1.10 mg·100 $g^{-1}$). The SDB and SDKB DBs had the highest amounts of EAA, Ratios of E:N, E:T, E:P and EAAI (%), which contained 46.654 and 44.853 g/16 g N, 0.983% and 0.890%, 0.496% and 0.471%, 0.467% and 0.449% and 86.86% and 83.51%, respectively. The amino acid methionine was the most deficient amino acid in all formulated DBs. The SDKB was the highest sensory characteristics, and it was followed by SDB to be 90.77% and 88.98%, respectively for instance.**

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**How to cite this paper:** Ghazal, G.A., Akasha, A.E.K.E. and Abobaker, A.A. (2016) Development of Novel Confectionary Bars by Utilizing Date "Tagyat Variety". *Food and Nutrition Sciences*, **7**, 533-543. http://dx.doi.org/10.4236/fns.2016.77055

## Keywords

**Tagyat Date, Date Bars, Minerals Daily Requirements, Amino Acids, Essential Amino Acids Index (EAAI), Sensory Evaluation**

## 1. Introduction

A healthy diet should meet individual nutritional needs and also incorporate cultural and gastronomic values that make it enjoyable. Since time immemorial, people have habitually consumed assortments of fruit and fruit products as a part of their regular diet. Owing to available databases on health promoting values, fresh fruits are considered as priority choice over snack foods. Today, consumers tend to prefer fresh fruits over their processed products such as: jams, jellies, juice, confectionaries, etc. [1]. In this regard, it is worthy to encourage people to consume more fruits on regular basis by introducing them to fruit bars. Available reports have indicated successful development of fruit-bars from apple, guava, jackfruit and mango [2]. Fruit bar is a concentrated fruit product that has superior nutritive and energy values. In addition, compared to fresh fruits, fruit bars tend to possess extended shelf-life. Fruit bars can be a wholesome nutritious food for all age groups, including elderly people. It can be an exceptional instant food that can deliver the required dietary fiber and other bioactive compounds, required to meet the daily requirements in humans [3]. A fruit bar can be prepared either from fresh fruits or from semi-dried fruits. Besides, preparation of nutritionally rich fruit bars by using dried fruit can be relatively much easier and convenient when compared to other fruit based products. In current study, we used date fruits (*Phoenix dactylifera*) verity "Tagyat"—common in Libya for preparing novel date-based bars (DBs). The global production of date fruits exceeds 6 million metric tons annually in the world (FAO). It can be considered as main staple food in North African countries and basis of survival for the inhabitants of the Algerian Sahara, especially during the Ramadan period, representing an important source of nutrients and energy [4].

Chemical composition of date fruits has been reported in various research works [5]-[7]. It is rich in minerals, vitamins and is an excellent material for producing refined sugar, concentrated juice, confectionery pastes and fermentation products [8]. Dates contain small amounts of vitamins C, $B_1$ thiamine, $B_2$ riboflavin, $B_3$, nicotinic acid, and vitamin A with very little or no starch [6] [9], and studies have shown that dates have strong antioxidant [10] [11], anticancer [12] and antiviral [13] activities. The dates are rich in sugar (71.2% - 81.4% dw), while ash represented 1.68% - 3.94%; they contained low concentrations of protein and lipid (1.72% - 4.73% and 0.12% - 0.72%, respectively) [14]. Also, date flesh is an important source of sugar (~81% -88%, mainly fructose, glucose and sucrose), dietary fibre (~5% - 8.5%) and small amounts of protein, fat, ash and polyphenols [5] [15] [16]. Tagyat date contained 614.87, 89.28, 41.74, 30.40, 3.71, 2.67, 0.98 and 0.45 mg/100 g on wet weight basis from K, P, Ca, Mg, Na, Fe, Zn, Cu and Mn respectively [17]. Thus, dates provide a good nutritional value based on their dietary fiber (DF) contents. DF has important therapeutic implications (e.g. for diabetes, obesity) and exhibits a protective effect [11] [16] [18]. The predominant mineral was potassium and their protein contained high concentrations of aspartic acid, proline, alanine, glycine, valine and leucine, low concentrations of threonine, serine, isoleucine, tyrosine, arginine, phenylalanine and lysine and very low concentrations of methionine and histidine [19]. Moreover, it contained valuable amount from carotenoids as mentioned by Boudries *et al*. [4]. On the other side, Vayalil [20] summarize the phytochemicals composition, nutritional significance, and potential health benefits of date fruit consumption and confirmed its great potential as a medicinal food for a number of diseases inflicting human beings. It is associated with providing rich nutritional and therapeutic values. The fruits are either consumed directly (fresh or in dried form) or are converted into products such as jam, wine, juice, vinegar, etc. [21]. However, DBs can be a better alternative to direct consumption of dates, especially during off-seasons. In addition, DBs can meet the increased demands of local and international consumers where this fruit is not grown [7]. Processing of fresh dates to develop new food products might be useful in generating good income to the growing region. As Tagyat date is very common in Libya, a manufacturing way will be a good chance to utilize the huge production of its amount and get health and economic benefits. Therefore, date fruits "Tagyat variety" are used for confectionary bar formulation. The main aim to undertake this study was to produce novel DBs by utilizing date "Tagyat variety" to produce novel confectionary bar with increasing the proteins, fat and fiber contents by adding sufficient ingredients. Results of this study are expected to obtain full benefit not only to the dependent industry but also envisaged to fulfill the growing needs of consumers.

## 2. Materials and Methods

### 2.1. Materials

Date "Tagyat variety" used in current study was obtained from a date farm located in Soknea, Gaffara, Libya. Thirty kilo gram of ripped date were taken in full ripe stage "Rutab stage", then transferred to Food Industrial Department, Faculty of Science Engineering and Technology, Sebha University, Libya and kept under cooling condition until used. Dried milk, peeled white sesame seeds, peeled peanut, grated coconut, cacao powder and corn starch were obtained from the local market at Sebha, Libya.

### 2.2. Preparation of Date-Based Bars

The natural ripped date fruits were cleaned, sorted, washed then ground by electric grinder (Siemens food processor—MK 55290 kitchen machine) to homogenate paste. A sample for raw date analysis was taken and the paste was divided into two portions then kept for data bar preparation. Date bars were prepared according to mentioned formulas in **Table 1**. Peeled peanut powder, peeled white sesame seeds and grated coconut were used as coating materials after the bars being formulated, mixed and shaped as 2 × 10 cm (WxL). After removing the excessive coating materials, the prepared bars were packaged in polyethylene pages then subjected to the analysis.

### 2.3. Proximate Chemical Composition and Minerals Content

The formulated confectionary DBs were subjected to chemical analysis (moisture, crude protein, crude lipids, ash, Total, reducing, non-reducing sugars) and caloric value according to methods of AOAC [22]. The minerals content includingsodium and potassium, were determined using flame photometry, while calcium, magnesium, iron, copper, manganese, zinc, cadmium, lead and mercury contents were determined by atomic absorption spectroscopy according to AOAC [22]. A standard colorimetric method was employed for phosphorus as mentioned by Borah *et al*. [23].

### 2.4. Determination of Amino Acid

The amino acids profile was carried out on DBs after using HPLC-PICO-TAY after hydrolysis by 6.0 N HCL for 24 h at 110˚C in evacuated ampoules. Quantitative determination of amino acids were carried out according to [24].

### 2.5. Chemical Determination of Tryptophan

Tryptophan was determined colorimetrically in the alkaline hydrolysate according to the method of Blouth *et al.* [25].

**Table 1.** Innovative date-based confectionary bar recipes.

| Ingredients[a] | Date-based confectionary bar (%) | | | | | |
|---|---|---|---|---|---|---|
| | CDB | SDB | PDB | CDKB | SDKB | PKDB |
| Date paste | 77 | 77 | 77 | 70 | 70 | 70 |
| Starch | 3 | 3 | 3 | 3 | 3 | 3 |
| Dried mill | 10 | 10 | 10 | 10 | 10 | 10 |
| Gratedcoconut | 10 | – | – | 10 | – | – |
| Peeled white sesame seeds | – | 10 | – | – | 10 | – |
| Peeled peanut powder | – | – | 10 | – | – | 10 |
| Cacao powder | – | – | – | 7 | 7 | 7 |

[a]: All mentioned ingredients were obtained on fresh status from the different local markets in Libya (see materials), CDB: DBs coated with grated coconut, SDB: DBs coated with peeled white sesame seeds, PDB: DBs coated with peeled peanut powder, CDKB: DBs contained 7% cacao powder and coated with grated coconut, SDKB: DBs contained 7% cacao powder and coated with peeled white sesame seeds and PKDB: DBs contained 7% cacao powder and coated with peeled peanut powder.

### 2.6. Organoleptic Analysis

Organoleptic attributes of different DBs were carried out. Twenty panelists of the staff members and students from Food Industrial Department, Faculty of Science Engineering and Technology, Sebha University, in the age range of 18 to 45 years were asked to evaluate the prepared DBs towards taste (25), odor (25), texture (20), color (15), and appearance (15). Results were subjected to analysis of variance and average of the mean values of the aforementioned attributes according to Wilson *et al.* [26].

### 2.7. Statistical Analysis

The statistical analysis was carried out using SPSS program with multi-function utility regarding to the experimental design under significance level of 0.05 for the whole results and multiple comparisons were carried out applying LSD according to Steel *et al.* [27].

## 3. Results and Discussion

### 3.1. Chemical Composition of Raw Materials

The proximate chemical composition used ingredients in novel DBs formulation are presented in **Table 2**. It could be noticed that Tagyat date had the higher moisture, total, reducing and non-reducing sugars contents (22.23%, 66.81%, 53.55% and 12.60%, respectively), while it contained the lowest contents from crude protein, crude fat and total ash (2.83%, 1.19% and 1.86%, respectively) compared with other ingredients. Dried milk, crushed peanut and peeled white sesame had the higher crude protein content being 31.94%, 28.59% and 23.99%, respectively. Meanwhile, Tagyat date and grated coconut had the lower protein content to be 2.83% and 6.68%, respectively. Peeled white sesame seeds, crushed peeled peanut and grated coconut had the highest amount of crude fat being 54.35%, 52.21% and 49.93%, respectively. In contrast, Tagyat date and cacao powder had lower crude fat content to be 1.19% and 3.09%, respectively. From the results in the same table, it could be noticed that dried milk and cacao powder had higher total ash content which contained 5.25 and 5.23%, respectively. On the other hand, the Cacao powder was the highest total carbohydrate content to reach 74.10%. These results are an agreement with those obtained by Soliman *et al.* [28], Ukasha [29], Akasha *et al.* [30] and Ghazal *et al.* [31].

### 3.2. Chemical Composition of Novel Prepared DBs

Proximate chemical composition and caloric value of six novel BDs prepared from previous raw materials are presented in **Table 3**. A significant difference ($p < 0.05$) was found among formulas with different rate at all chemical composition parameters and energy value. The moisture content of BDs was in range of 16.16 in CDKB to 17.49% in SDB. The crude protein content of the six BDs varied from 9.16% in PDB to 12.35% in SDKB. In the same context, SDKB was also recorded as the highest crude fat and energy value to be 11.75% and 382.87%, respectively. However, CDB had bottomed in crude fat and energy to arrive 10.32% and 372.28. Data presented in **Table 3** showed that ash content was ranged from 2.39% to 2.78% in PDB and CDKB, re-

**Table 2.** Chemical composition of used ingredients in novel DBs formulation (gm 100 $g^{-1}$).

| Components* | Raw materials | | | | | | LSD |
|---|---|---|---|---|---|---|---|
| | Tagyat date paste | Peeled crushed peanut | Peeled white sesame seeds | Dry milk | Cacao powder | Grated coconut | |
| Moisture | 22.23$^{a}$ | 3.78$^{c}$ | 2.34$^{d}$ | 7.55$^{b}$ | 4.05$^{c}$ | 2.29$^{d}$ | 0.44 |
| Crude protein | 2.83$^{f}$ | 28.59$^{b}$ | 23.99$^{c}$ | 31.94$^{a}$ | 13.53$^{d}$ | 6.68$^{e}$ | 1.24 |
| Crude fat | 1.19$^{f}$ | 52.21$^{b}$ | 54.35$^{a}$ | 25.92$^{d}$ | 3.09$^{e}$ | 49.93$^{c}$ | 0.26 |
| Total ash | 1.86$^{d}$ | 2.46$^{c}$ | 3.91$^{b}$ | 5.25$^{a}$ | 5.23$^{a}$ | 1.85$^{d}$ | 0.12 |
| Total carbohydrates | 71.89$^{b}$ | 12.96$^{f}$ | 15.41$^{e}$ | 29.34$^{d}$ | 74.10$^{a}$ | 39.25$^{c}$ | 2.35 |

$^{a, b, c, d, e, f}$: There is no significant difference ($P > 0.05$) between any two means within the same rows that have the same superscript letter, $^{*}$: The chemical composition was calculated on the wet weight base.

**Table 3.** Chemical composition of novel prepared DBs.

| Components | Chemical composition* of DBs | | | | | | LSD |
|---|---|---|---|---|---|---|---|
| | CDB | SDB | PDB | CDKB | SDKB | PKDB | |
| Moisture% | 17.30$^{a}$ | 17.49$^{a}$ | 17.44$^{a}$ | 16.16$^{b}$ | 16.33$^{b}$ | 16.38$^{b}$ | 0.94 |
| Crude protein% | 11.20$^{b}$ | 10.72$^{bc}$ | 9.16$^{d}$ | 12.35$^{a}$ | 11.89$^{a}$ | 10.31$^{c}$ | 0.63 |
| Crude fat% | 10.32$^{d}$ | 11.53$^{b}$ | 11.0$^{c}$ | 11.24$^{c}$ | 11.75$^{a}$ | 11.51$^{b}$ | 0.09 |
| Total ash% | 2.53$^{c}$ | 2.46c$^{d}$ | 2.39$^{d}$ | 2.78$^{a}$ | 2.64$^{b}$ | 2.63$^{b}$ | 0.07 |
| Total carbohydrates% | 56.65$^{c}$ | 57.80$^{cd}$ | 59.81$^{a}$ | 57.97$^{c}$ | 57.39$^{d}$ | 59.17$^{b}$ | 0.57 |
| Total sugars% | 47.99$^{a}$ | 48.07$^{a}$ | 48.00$^{a}$ | 46.32$^{c}$ | 46.58$^{bc}$ | 46.87$^{b}$ | 0.37 |
| Reducing sugars% | 42.86$^{ab}$ | 43.08$^{a}$ | 42.63$^{ab}$ | 41.14$^{c}$ | 42.49$^{b}$ | 41.48$^{c}$ | 0.51 |
| Non-reducing sugars% | 4.87$^{b}$ | 4.74$^{c}$ | 5.10$^{a}$ | 4.92$^{b}$ | 3.89$^{d}$ | 5.15$^{a}$ | 0.13 |
| Energy K cal.100g$^{-1}$ | 372.28$^{d}$ | 377.85$^{c}$ | 376.68$^{c}$ | 380.44$^{b}$ | 382.87$^{a}$ | 381.51$^{ab}$ | 1.86 |

$^{a,b,c,d}$: There is no significant difference ($p > 0.05$) between any two means within the same rows that have the same superscript letter, $^{*}$: The chemical composition was calculated on the wet weight base.

spectively. These results are higher than those obtained by Abd El-Fattah (1995). All formulated diets seem to have adequate carbohydrate content which ranged from 56.65 in CDB to 59.81% in PDB. The Total and reducing sugar contents varied from 46.32% to 48.07% and 41.14% to 43.08% in CDKB and SDB, respectively. These results are in agreement with results obtained by Abd El-Fattah [32].

### 3.3. Minerals Content of Novel Prepared DBs

The minerals content in novel DBs was tabulated in **Table 4**. Remarkably, the CDB was higher all major elements than other formulas. Conversely, PDB was lower such elements than other formulas. The predominant mineral was potassium recorded highest content (719.85 mg·100 g$^{-1}$) in CDB while it was recorded the lowest content (621.94 mg·100 g$^{-1}$) in PDB.CDB, CDKB and SDB showed higher P than all formulas to be 113.83, 104.83 and 103.17 mg·100 g$^{-1}$, respectively. These results are lower than those obtained by Abd El-Fattah [32]. Amazingly, PDB recorded the lowest all major elements than other formulas. Concerning CDKB showed the second rate followed by in its content of all major elements. A small difference was found among all formulas. Iron content in different formulas is given in the same table, which was ranged from 3.29 in SDB to 5.14 mg·100 g$^{-1}$ in CDKB. Likewise, CDB and CDKB had peaked in its content of copper and manganese to be 1.40 and 1.37 and 1.10 and 1.08 mg·100 g$^{-1}$ comparing with other formulas, while CDB and CDKB were the highest zinc to around 3.60 and 3.53 mg·100 g$^{-1}$. Concerning the lowest minor elements content, the PDB was lower zinc, copper and manganese than other formulas. Obtained results are in agreements of iron and manganese and higher of zinc and copper with found by Abd El-Fattah [32]. This difference may be due to the type of date, geographical conditions and climate. According to the aforementioned data it could be said that, if a baby was given 100 g of any novel DBs would provide the baby with about 15% - 19% or calcium, 48% - 100% for magnesium, 52% - 94% for iron, 66% for zinc and 77% - 100% for copper of the recommended by FAO [33] and NAS [34]. It is apparent that novel DB$_s$ contain appreciable amounts of Ca, Mg, P, Fe, Zn and Cu compared to many other food sources. Novel DB$_s$ are rich source of Ca (average content of 76.57 mg/100g on dry basis) is higher than Cow's milk which reorted to contain 72 mg·100 g$^{-1}$ [35]. The average concentration of Mg in novel DB$_s$ (48.14 mg 100 g$^{-1}$ on dry basis) is quite higher than those found in human milk or Cow's milk 4 and 12 mg/100 ml, respectively [34]. The amount of P present in novel DB$_s$ (average value 121.05 mg·100g$^{-1}$ on dry basis) approaches ½ that present in whole dry milk 250 mg·100 g$^{-1}$ [35]. With an average value of about 4.71 mg/100 g on dry basis of iron, novel DB$_s$ could be considered a rich source of iorn when compared with milk and milk products which are reported to contain less than 1 mg·100 g$^{-1}$ [35]. Taking in concentration that zinc is becoming more deficient in human foods [34], an average value of 3.97 mg·100 g$^{-1}$ on dry basis could be considered as rich source better than milk (3 - 5 µg·g$^{-1}$). Having an average value of 1.54 mg·100 g$^{-1}$ on dry basis, novel DB$_s$ are a good source for Cu compared to human milk (0.6 - 1.05 mg·L$^{-1}$) as reported by FAO [33].

**Table 4.** The minerals content of novel prepared DBs (mg $100g^{-1}$ on wet weight base).

| Minerals | | Minerals content of DBs (mg 100 $g^{-1}$) | | | | | | LSD |
|---|---|---|---|---|---|---|---|---|
| | | CDB | SDB | PDB | CDKB | SDKB | PKDB | |
| Major elements | K | 719.85$^{a}$ | 645.89$^{b}$ | 621.94$^{b}$ | 707.27$^{a}$ | 629.09$^{b}$ | 625.82$^{b}$ | 49.13 |
| | P | 113.83$^{a}$ | 103.17$^{b}$ | 92.53$^{c}$ | 104.83$^{b}$ | 93.58$^{c}$ | 95.95$^{c}$ | 3.61 |
| | Ca | 69.48$^{a}$ | 62.78$^{b}$ | 59.77$^{b}$ | 68.61$^{a}$ | 61.05$^{b}$ | 60.34$^{b}$ | 4.76 |
| | Mg | 43.81$^{a}$ | 39.59$^{b}$ | 37.69$^{b}$ | 42.88$^{a}$ | 38.43$^{b}$ | 38.04$^{b}$ | 2.03 |
| | Na | 35.48$^{a}$ | 29.94$^{c}$ | 28.41$^{d}$ | 34.66$^{b}$ | 28.76$^{d}$ | 28.73$^{d}$ | 0.51 |
| Minor elements | Fe | 4.22$^{b}$ | 3.29$^{d}$ | 3.53$^{cd}$ | 5.14$^{a}$ | 3.70$^{c}$ | 3.66$^{c}$ | 0.31 |
| | Zn | 3.60$^{a}$ | 3.27$^{b}$ | 3.10$^{b}$ | 3.53$^{a}$ | 3.16$^{b}$ | 3.13$^{b}$ | 0.25 |
| | Cu | 1.40$^{a}$ | 1.26$^{b}$ | 1.21$^{b}$ | 1.37$^{a}$ | 1.23$^{b}$ | 1.21$^{b}$ | 0.09 |
| | Mn | 1.10$^{a}$ | 0.99$^{b}$ | 0.95$^{b}$ | 1.08$^{a}$ | 0.96$^{b}$ | 0.96$^{b}$ | 0.07 |
| | Cd | - | - | - | - | - | - | |
| | Pb | - | - | - | - | - | - | |
| | Hg | - | - | - | - | - | - | |

$^{a, b, c, d}$: There is no significant difference ($P > 0.05$) between any two means within the same rows that have the same superscript letter, -Not detected.

## 3.4. Amino Acids Content of Novel Prepared DBs

Surely, amino acid compositional data are only the first in the nutritional assessment of any food protein. The amino acids composition for isolated protein from different formulas is given in **Table 5**. Obtained data showed that, seventeen amino acids were identified. Obviously, the SDB was the highest essential amino acids than other formulas, whilst the CDKB was the lowest essential amino acids. Then, leucine and lysine recorded the highest amount essential amino acids at all different formulas, it shows a value of 0.459 and 0.440, 0.371 and 0.428, 0.415 and 0.433, 0.339 and 0.389, 0.432 and 0.431 and 0.403 and 0.418 $g \cdot g^{-1}$ nitrogen in SDB, CDB, PDB, CDKB, SDKB and PKDB, respectively. Also, the SDB was higher methionine, lysine and histidine than hens' egg as represented in FAO [36]. On the other hand, the SDB had bottomed in some non-essential amino acids like aspartic, glutamic, serine and proline. Nevertheless, the PDB was the lowest formulas in its content from glycine, alanine and argenine. Conversely, the CDKB had peaked at the most of non-essential amino acids and it was replaced by PKDB, PDB and SDKB in aspartic, serine and argenine, respectively. Thus, the SDB and SDKB were the highest EAA and the lowest N-EAA and vice versa in CDKB; however, the SDKB and SDB had peaked in total amino acids.

## 3.5. Evaluation of Novel Prepared DBs Amino Acids

Data in **Table 6** illustrate the nutritional evaluation of DBs proteins. From the results, it could be noticed that the SDB, SDkB and PDB, $DB_s$ had the highest amount of EAA, ratios of E:N, E:T, E:P and EAAI (%), which contained 46.654, 44.853 and 44.234 g/16 g nitrogen, 0.983, 0.890 and 0.878 for E:N, 0.496, 0.471 and 0.468 for E:N ratio, 0.467, 0.449 and 0.422 for E:P ratio and 86.86%, 83.51% and 82.36% for EAAI. Thus, it was recorded higher than beef' protein and lower than egg' protein according to FAO [36].

## 3.6. Assessment of DBs Amino Acids Level Individually to Total Essential Amino Acids

As recommended by FAO and WHO, there are two main categories being very important for determining the protein quality, one of them in depends on calculating individual (A) to essential (E) amino acids ratios. Ratios for the tested protein as well as these for different FAO patterns, hen's egg and cow's milk (control ratio). Data in **Table 7** illustrated the assessment of each amino acid level individually to total essential amino acids of DBs comparing them to the available amino acids references. From these results, it could be noticed that methionine

**Table 5.** The amino acids content (g $g^{-1}$ nitrogen) of novel prepared DBs.

| Amino acids | Treatments | | | | | | Hens egg (FAO, 1970) |
|---|---|---|---|---|---|---|---|
| | CDB | SDB | PDB | CDKB | SDKB | PKDB | |
| Therionine | 0.203 | 0.248 | 0.229 | 0.198 | 0.237 | 0.218 | 0.320 |
| Valine | 0.308 | 0.367 | 0.351 | 0.303 | 0.363 | 0.326 | 0.428 |
| Methionine | 0.207 | 0.216 | 0.203 | 0.198 | 0.206 | 0.183 | 0.210 |
| Isoleucine | 0.338 | 0.391 | 0.323 | 0.267 | 0.369 | 0.292 | 0.393 |
| Leucine | 0.371 | 0.459 | 0.415 | 0.339 | 0.432 | 0.403 | 0.551 |
| Tyrosine | 0.194 | 0.214 | 0.208 | 0.189 | 0.208 | 0.193 | 0.260 |
| Lysine | 0.428 | 0.440 | 0.433 | 0.389 | 0.431 | 0.418 | 0.436 |
| Phenylalanine | 0.298 | 0.324 | 0.316 | 0.252 | 0.309 | 0.304 | 0.358 |
| Histidine | 0.165 | 0.161 | 0.159 | 0.158 | 0.154 | 0.152 | 0.152 |
| Tryptophan | 0.098 | 0.108 | 0.102 | 0.094 | 0.106 | 0.098 | 0.110 |
| Aspartic | 0.704 | 0.625 | 0.715 | 0.714 | 0.637 | 0.768 | 0.601 |
| Glutamic | 0.836 | 0.703 | 0.743 | 0.862 | 0.782 | 0.798 | 0.796 |
| Serine | 0.328 | 0.265 | 0.412 | 0.359 | 0.273 | 0.401 | 0.478 |
| Proline | 0.309 | 0.272 | 0.281 | 0.331 | 0.286 | 0.296 | 0.260 |
| Glycine | 0.241 | 0.258 | 0.203 | 0.277 | 0.269 | 0.224 | 0.207 |
| Alanine | 0.418 | 0.398 | 0.372 | 0.434 | 0.407 | 0.393 | 0.370 |
| Argenine | 0.416 | 0.458 | 0.393 | 0.431 | 0.474 | 0.413 | 0.381 |
| Total of EAA | 2.610 | 2.928 | 2.739 | 2.437 | 2.815 | 2.587 | 3.218 |
| Total of N-EAA | 3.252 | 2.979 | 3.119 | 3.408 | 3.164 | 3.293 | 3.093 |
| Total of amino acids | 5.862 | 5.907 | 5.858 | 5.845 | 6.009 | 5.880 | 6.311 |
| % protein | 11.20 | 10.72 | 9.16 | 12.35 | 11.89 | 10.31 | 12.78 |

EAA: Essential amino acids. N-EAA: Non-essential amino acid.

**Table 6.** The nutritional evaluation of novel prepared DBs proteins.

| DBs | Item | | | | | |
|---|---|---|---|---|---|---|
| | EAA g 16 g N | N-EAA g 16 g N | E:N ratio | E:T ratio | E:P ratio | EAAI (%) |
| CDB | 41.587 | 51.816 | 0.803 | 0.445 | 0.416 | 77.43 |
| SDB | 46.654 | 47.467 | 0.983 | 0.496 | 0.467 | 86.86 |
| PDB | 44.234 | 50.371 | 0.878 | 0.468 | 0.442 | 82.36 |
| CDKB | 38.830 | 54.302 | 0.715 | 0.417 | 0.338 | 72.30 |
| SDKB | 44.853 | 50.414 | 0.890 | 0.471 | 0.449 | 83.51 |
| PKDB | 41.780 | 53.181 | 0.786 | 0.440 | 0.418 | 77.79 |
| Egg FAO (1970) | 53.709 | 45.571 | 1.179 | 0.541 | 0.537 | 100.00 |
| Beef FAO (1970) | 42.724 | 57.276 | 0.746 | 0.427 | 0.427 | 79.55 |

E:N ratio of essential amino acids to non-essential amino acids; E:T ratio of essential amino acids to total amino acids; E:P ratio of essential amino acids to protein; EAAI-Essential amino acid index according to Oser (1959).

**Table 7.** Individual (A) to essential (E) amino acids ratios for proteins of novel prepared DBs.

| DBs | Amino acids in DBs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Therionine | Valine | Methionine | Isoleucine | Leucine | Tyrosine | Lysine | Phenylalanine | Histidine | Tryptophan |
| CDB | 78 | 118 | 79 | 129 | 142 | 74 | 114 | 163 | 63 | 37 |
| SDB | **85** | 125 | 74 | **134** | **157** | 73 | 111 | 150 | 55 | 37 |
| PDB | 84 | 128 | 74 | 118 | 152 | **76** | 115 | 158 | 58 | 37 |
| CDKB | 81 | 124 | **81** | 110 | 139 | **76** | 103 | 160 | 65 | 39 |
| SDKB | 84 | **129** | 73 | 131 | 153 | 74 | 110 | 153 | 55 | 38 |
| PKDB | 84 | 126 | 71 | 113 | 156 | 75 | 118 | 162 | 59 | 38 |
| Hens egg FAO (1970) | 85 | 119 | 103 | 98 | 155 | 102 | 140 | 126 | 40 | 30 |
| FAO/WHO (1970) | 93 | 140 | 140 | 140 | 160 | 186 | | 140 | - | 46 |
| FAO (1973) | 111 | 134 | 100 | 111 | 200 | 171 | | 157 | - | 29 |
| Hens egg FAO (1973) | 99 | 139 | 120 | 114 | 182 | 147 | | 148 | - | 31 |
| Cow's milk FAO (1973) | 95 | 138 | 71 | 101 | 205 | 215 | | 168 | - | 28 |

A/E Ratio = mg amino acid per grams total essential amino acids.

was the most deficient amino acid in all formulated DBs. The lower ratios than controls were observed for Therionine and leucine in all formulated $DB_s$ and addition of valine in CDB $DB_S$. Although differed greatly, the ratios for other essential amino acids matched or exceeded the corresponding ratios of the controls.

### 3.7. The Certain Amino Acids

Data in **Table 8** shows the certain amino acids of each formulated DB comparing to FAO pattern $mg \cdot g^{-1}$ protein. With regard to the limiting amino acids of formulated DBs, it could be noticed that the Therionine is the most deficient and the first limitingacid in CDB, PDB and SDKB, while the first limiting amino acid was tyrosine, isoleucine and methionine in SDB, CDKB and PKDB. The second limiting amino acid was methionine in SDB, PDB and SDKB, while it was Therionine in CDKB and PKDB and it was isoleucine in CDB. The third limiting amino acid was tyrosine in CDB, SDKB and PKDB, while it was Therionine, isoleucine and phenylalanine in SDB, PDB and CDKB, respectively.

### 3.8. Organoleptic Evaluation of DBs

Sensory evaluation of food products is an important criterion by which its consumer acceptability can be assessed. Thus, six DBs were formulated and organoleptically evaluated toward taste, odor, texture, color, and appearance where the overall acceptability was the summation of given score, **Table 9**. Surely, significant differences ($p < 0.05$) were observed among formulas in order its parameter. Generally, The PDB and PKDB have bottomed comparing to other formulas, conversely, the SDB and SDKB have peaked. For example, the SDKB was the highest sensory characteristics, and it was followed by SDB to be 90.77% and 88.98%, respectively for instance. Also, lowest texture was observed in CDB being 15.60%. However, the CDKB was listed as the lowest color around to 11.23%. Moreover, the overall acceptability scores indicated that the different diets could be arranged as PDB > PKDB > CDKB > CDB > SDB > SDKB.

## 4. Conclusion

The present work investigated the applicability of preparing different DBs with high nutritional value and good organoleptic characteristics. This novel DBs can be consumed as a healthy snack food, ready-to-eat food or as a

**Table 8.** Scores of essential amino acids to limiting the three essential amino acids responsible for limiting the quality of protein of formulated DBs.

| Amino acids | BDs | | | | | | Pattern mg·g$^{-1}$ protein* |
|---|---|---|---|---|---|---|---|
| | CDB | SDB | PDB | CDKB | SDKB | PKDB | |
| Therionine | **81** | **99** | **80** | **79** | **94** | **88** | 40 |
| Valine | **98** | 116 | 113 | **97** | 116 | 105 | 50 |
| Methionine | **94** | **98** | **94** | **90** | **94** | **84** | 35 |
| Leucine | 135 | 156 | 130 | 106 | 147 | 118 | 40 |
| Isoleucine | **84** | 104 | **95** | **77** | **98** | **93** | 70 |
| Tyrosine | **88** | **97** | **96** | **86** | **95** | **89** | 35 |
| Phenylalanine | **99** | 108 | 106 | **84** | 103 | 102 | 48 |
| Lysine | 124 | 127 | 127 | 113 | 125 | 123 | 35 |
| Histidine | 125 | 122 | 122 | 120 | 117 | 117 | 21 |
| Tryptophan | 156 | 172 | 165 | 150 | 169 | 158 | 10 |
| First AA | Therionine | Tyrosine | Therionine | Isoleucine | Therionine | Methionine | |
| Second AA | Isoleucine | Methionine | Methionine | Therionine | Methionine | Therionine | |
| Third AA | Tyrosine | Therionine | Isoleucine | Phenylalanine | Tyrosine | Tyrosine | |

*According to FAO/WHO AD HOC Committee (FAO, 1973).

Amino acid score according to FAO $(1973) = \frac{\text{mg amino acid in 1 g protein}}{\text{mg amino acid sugested by FAO/WHO}} \times 100$. Under line preferred that the lowest percentage compared to FAO pattern.

**Table 9.** Organoleptic characteristics of novel prepared DBs.

| Organoleptic characteristics | DBs | | | | | | LSD |
|---|---|---|---|---|---|---|---|
| | CDB | SDB | PDB | CDKB | SDKB | PKDB | |
| Taste | 19.07$^{bc}$ | 21.80$^{a}$ | 17.30$^{b}$ | 19.33$^{b}$ | 22.27$^{a}$ | 17.53$^{bc}$ | 2.02 |
| Oder | 20.60$^{ab}$ | 22.65$^{a}$ | 17.80$^{b}$ | 19.57$^{b}$ | 22.67$^{a}$ | 17.50$^{c}$ | 2.03 |
| Texture | 15.60$^{b}$ | 17.80$^{a}$ | 15.7$^{b}$ | 15.93$^{b}$ | 18.20$^{a}$ | 16.33$^{b}$ | 1.73 |
| Color | 11.30$^{b}$ | 13.20$^{a}$ | 12.00$^{b}$ | 11.23$^{b}$ | 13.50$^{a}$ | 11.97$^{b}$ | 1.29 |
| Appearance | 11.77$^{b}$ | 13.53$^{a}$ | 10.70b$^{c}$ | 11.63$^{bc}$ | 14.13$^{a}$ | 10.40$^{c}$ | 1.25 |
| Overall acceptability | 78.34$^{b}$ | 88.98$^{a}$ | 73.07$^{c}$ | 77.69$^{b}$ | 90.77$^{a}$ | 73.73$^{c}$ | 4.41 |

$^{a,b,c}$: There is no significant difference ($P > 0.05$) between any two means within the same row have the same superscript letter.

dessert with good shelf-life stability. It can also find applicability as an appetizer, especially in countries where Islam religion is followed and where people consume fresh dates after breaking the fast during Ramadan month. Furthermore, adding wanted food additives for optimizing the production of DBs may have a good impact commercially. Formulating such functional DBs and producing them in different form could be investigated further.

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