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Nutritional Composition and Sensory Evaluation of Vitamin D-enriched Date Milk as An Alternative Food Supplement for Preschool Children

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Abstract

Insufficient intake of calcium, vitamin D, iron, and zinc is linked to the prevalence of malnutrition among Indonesian preschoolers. Creating additional food formulations to meet nutritional requirements is one of the methods for addressing dietary issues. Milk and dates can be used to create alternative food supplements in the form of beverages. This research aimed to develop a date milk product enriched with vitamin D as an alternative diet supplement for preschoolers. The experiment consisted of three formulations of vitamin D-enriched date milk with the addition of date flesh: F1 (10%), F2 (15%), and F3 (20%), with F0 (100% liquid milk) serving as the control. The results indicated that F3 had the maximum energy, fat, and carbohydrate levels compared to other formulations. Adding amounts of 10%, 15%, and 20% date flesh significantly impacted the energy value, moisture content, ash, protein, and carbohydrates, but not the fat content. The nutritional values of calcium, iron, and zinc in F1, F2, and F3 significantly differed from those of the control group F0. Each formulation, F1, F2, and F3, contained the same amount of vitamin D. Date milk fortified with vitamin D and having 15% date flesh (F2) was the most preferred formulation in terms of aroma, flavour, mouthfeel, aftertaste, and overall acceptance. In contrast, the F0 formulation has the finest colour and consistency. There was no significant difference in overall acceptability between formulations.

Keywords: Date Milk, Food Supplement, Preschooler, Vitamin D Fortification

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1. Introduction

Nutritional problems that occur in preschool children in Indonesia include being not only undernourished but also stunted. According to Basic Health Research (Riskesdas), the prevalence among preschool-aged children who meet the criteria for very short and short is 7% and 19.2%, respectively [1]. One of the causes of stunting is inadequate micronutrient intake [2]. Insufficient intake of calcium, vitamin D, iron, and zinc is associated with the incidence of stunting in preschool children in Indonesia [3] [4] [5]. Developing additional food formulas to help preschool-aged children meet their nutritional requirements is one way to combat dietary problems [6]. Foodstuffs that can be transformed into additional food formulations, such as milk and dates, are combined to create a date milk drink beneficial for linear growth. Milk contains protein, vitamins (A, B1, B2, and E), calcium, phosphorus, magnesium, zinc, and the mineral selenium, which can be very helpful in growth. Milk is an excellent source of protein, as it contains whey protein (20% of milk protein) and casein (80% of milk protein) [7]. Whey is a water-soluble protein consisting of globular proteins such as beta-lactoglobulin and alpha-lactalbumin and the amino acids leucine, isoleucine, valine, and lysine. Casein is a protein insoluble in water and contains higher concentrations of histidine, methionine, phenylalanine, and proline [8]. Casein influences growth via the bone mineralization process by increasing intestinal absorption of calcium [9]. Bone growth is regulated by glycosylate lactoferrin, iron, and calcium-binding protein (Ca2+) in whey [10].

Dates contain a variety of nutrients, including carbohydrates (85% simple sugars, namely glucose, fructose, and sucrose), protein (methionine and cysteine), complex B vitamins such as thiamine, niacin, riboflavin, pantothenic acid, pyridoxine, and folate, Vitamin K, and trace amounts of Vitamin C [11]. Moreover, dates contain the minerals calcium, iron, cobalt, fluoride, copper, magnesium, potassium, sodium, manganese, phosphorus, sodium, zinc, sulfur, boron, and selenium [12]. One hundred grams can provide 15% of the recommended daily allowance for copper, selenium, magnesium, and potassium minerals and 7% of the RDA for calcium, iron, manganese, and phosphorus [13].

Dates are rich in phytochemicals, including flavonoids, sterols, phenolics, anthocyanins, carotenoids, and procyanidins. In addition to these pharmacological benefits, the phytochemical constituents of dates contribute to their nutritional and sensory properties, allowing them to be used as a flavour enhancer in a variety of dairy products such as ice cream, yoghurt, pastries, and cakes [14]. These dairy products typically contain date syrup or date liquid but not date flesh [15].

Vitamin D levels in fresh milk are very low, ranging between 0.13–1.0 g/L and 0.03–1.8 g/kg in organic fresh milk. Therefore, milk is considered an inadequate source of vitamin D. [16] Due to the absence of vitamin D in dates, the formulation of this product requires vitamin D fortification [13] ([14]. Milk fortification with vitamin D has successfully increased vitamin D intake in many countries [17]. Vitamin D supplementation is required to maximize the growth benefits of milk. Vitamin D promotes bone health at all phases of life by regulating phosphorous-calcium metabolism and controlling bone remodelling [18]. Rickets is a bone formation and mineralization disease in neonates and children caused by a calcium and vitamin D deficiency during bone development. Clinical symptoms of rickets include deformities of the bone affecting the entire skeleton, very long bones, and metaphyseal cartilage growth. Severe rickets can lead to short stature [19]. Product development incorporating date flesh and milk is still quite limited. Therefore, this study aims to develop a date milk product enriched with vitamin D using liquid milk and dates of the Sukkari variety, perform proximate analysis and micronutrient content, and analyze sensory tests of alternative food supplements in preschool children.

2. Materials and methods

2.1 Materials

Ultra High Temperature (UHT) liquid milk in tetra pack packaging and carboxymethylcellulose (CMC) emulsifier were purchased from supermarkets; Sukkari dates were purchased from distributors; The fortificant *Dry Vitamin D3 100 CWS/AM* which is produced by *DSM Nutritional Products Ltd*. *Switzerland* was used. Distilled water was procured from a Bogor, Indonesia pharmacy to dissolve the vitamin D supplement. Laboratories for chemical analysis provide chemicals for proximate analysis and nutritional content examination.

2.2 Preparation of date pulp

The first step in material preparation is sorting the dates by selecting only the finest fruits, then washing and separating the pulp from the seeds.

2.3 Preparation of vitamin D fortifiers

A total of 0.12 grams of dry vitamin D3 powder (100 CWS/AM, DSM Nutritional Products Ltd., Switzerland) was diluted in 10 ml of distilled water, and up to 4 ml of the fortifying solution was added to date milk to achieve a 600 IU/200 mL per serving dose of vitamin D3 [20].

2.4 Formulation and preparation of date milk-enriched vitamin D

The production of date milk was based on research in [21] in which milk was modified by adding date flesh 10% (F1), 15% (F2), and 20% (F3). The milk in which no date flesh was added was used as a control group (F0). Liquid milk, date flesh, and CMC are blended for 2 minutes at 35,000 rpm/minute until homogeneous. With all the ingredients incorporated, filter cloth is then used to separate the date pulp [22]. The pasteurization process is carried out using the High-Temperature Short Time (HTST) method, a heating process with a temperature of 75ºC for a minimum of 15 seconds [23]. Date milk is pasteurized in a double boiler, which consists of a large pot filled with water to a depth of 7.5 to 10 cm and a smaller pot filled with date milk. The bottoms of the two pots do not come into contact to reduce the likelihood of scorched date milk. Date milk is boiled over medium heat while stirring so that it becomes homogeneous and does not burn. A culinary thermometer is used for temperature measurement. The boiled date milk is then cooled to 10°C in a frigid water basin [24]. The date milk product is placed in a 200-ml container using a UVC box sterilizer at 60ºC for 30 minutes and then stored at 4ºC [25]. Table 1 displays date formulas for milk fortified with vitamin D.

Table 1: Formulation of date milk drinks fortified with vitamin D

Ingredients (gr)	F0 (0%) (w/w)	F1 (10%) (w/w)	F2 (15%) (w/w)	F3 (20%) (w / w)
Liquid milk	3502	3502	3502	3502

Date flesh	-	340	510	680
Carboxymethylcellulose	-	7.0	7.0	7.0
Cholecalciferol (D3) 100%	-	0.00025 5	0.000255	0.000255
Distilled water	-	68	68	68

2.5 Proximate analysis

Determination of the sample proximate composition of water, ash, fat, protein, and carbohydrate content was done using the AOAC method [26]. The gravimetric method was used to analyze moisture and ash content, the Kjeldahl method for protein, the soxhlet -hydrolysis method for fat, and the by-difference method for carbohydrate content. Carbohydrates (%) = 100% - % (moisture content + ash + fat + protein) [27]. Proximate analysis was carried out at The MBrio Food Laboratory.

2.6 Determination of caloric (energy) value

The energy content per 100-gram sample of each formulation was calculated using the Atwater conversion factor by adding the values of carbohydrates, proteins, and fats multiplied by their respective caloric values, namely four calories for protein, nine calories for fat, and four calories for carbohydrates.

Calorie (energy) Value = 4*CHO + 4*Protein + 9*Fat [28].

2.7 Micronutrient analysis

The mineral contents, namely calcium, zinc, and iron, of all formulations of date milk were analyzed using the ICP-OES method, adapting the [29]guidelines. In contrast, the analysis of vitamin D content used the HPLC method, adapting the [30]guidelines. Tests of calcium, zinc, iron, and vitamin D were carried out at the Saraswati Indo Genetech Laboratory.

2.8 Sensory analysis

Sensory evaluation of vitamin D-enriched date milk was carried out by 30 semi-trained panellists who were students of the Department of Nutrition Science, Faculty of Human Ecology, IPB University, Bogor, Indonesia. Sensory evaluation was conducted at the Food Experiment Laboratory and Sensory Analysis Laboratory, Department of Nutrition, IPB University, between 8 a.m. and 2 p.m. Panelists were asked to rate the product based on preference using a seven-point hedonic scale: 1) disliked very much much; 2) dislike moderately; 3) dislike slightly; 4) neither like nor dislike; 5) like slightly; 6) like moderately; 7) likes very much; the parameters of assessment included; colour, aroma, taste, viscosity, mouth feel, aftertaste, and the overall acceptability [28]. Vitamin D-fortified date milk samples were presented in identical containers and assigned a three-digit random number code. Each sample with a different number was presented randomly, one at a time for each panelist. The panellists were offered water to cleanse their mouths between tastings of date milk containing vitamin D.

2.9 Statistical analysis

The data was analyzed using IBM SPSS Statistics 24.0 (SPSS Inc., Chicago, IL) software. The results of this study were presented as the mean standard deviation. The one-way ANOVA test was applied to the analysis of proximate and micronutrient data and sensory evaluation data. A Tukey HSD follow-up test determined the significance of the mean difference ($P < 0.05$).

3. Results and Discussions

3.1 Proximate analysis of date milk enriched vitamin D

The composition (energy values, moisture, ash, fat, protein, and carbohydrate) of date milk is shown in Table 2.

Table 2 Proximate analysis of fortified date milk

Parameters (units)	Formulas			
	F0	F1	F2	F3
Energy (Kcal/100g)	76.07 ± 12.78^{a}	92.69 ± 7.23^{a}	102.91 ± 7.55^{ab}	113.70 ± 7.50^{bc}
Moisture content (g/100g)	73.58 ± 1.86^{a}	82.23 ± 0.80^{b}	79.57 ± 0.29^{c}	77.26 ± 0.59^{d}
Ash content (g/100g)	0.98 ± 0.92^{a}	0.77 ± 0.04^{b}	0.83 ± 0.02^{ab}	0.82 ± 0.10^{ab}
Fat (g/100g)	3.68 ± 0.20^{a}	4.91 ± 0.84^{a}	4.94 ± 1.31^{a}	5.21 ± 1.10^{a}
Protein (g/100g)	3.20 ± 0.23^{a}	2.68 ± 0.09^{bc}	3.13 ± 0.09^{a}	2.42 ± 0.14^{c}
Carbohydrates (g/100g)	9.35 ± 0.40^{a}	9.41 ± 0.07^{a}	11.54 ± 0.98^{b}	14.27 ± 0.75^{c}

Note: Values are mean ± SD. F1 = 10% date flesh; F2 = 15% date flesh; F3 = 20% date flesh; F0 = control (100% liquid milk). Different superscripts within the same row indicated significant differences ($p < 0.05$).

Based on the proximate analysis of F3 with 20% date flesh added, the highest energy level was 113.70 Kcal/100g, whereas F0 (100% liquid milk) showed the lowest, with 76.07 Kcal/100g. The energy content of F0 was significantly different compared to F2 and F3. All the date milk formulations were not significantly different except F1 and F3 ($P<0.05$). The fruit of the Sukkari variety, which is used as a raw material for the formulation of a date milk drink enriched with vitamin D, has a relatively high energy content of 342 kcal per 100 grams of date [31]. The percentage of date flesh added affects the energy content of date milk enriched with vitamin D, with a higher percentage of date flesh added resulting in higher energy content.

Table 2 reveals that F1 has the highest moisture content, 82.23 g/100 g, while F0 has the lowest, 73.58 g/100 g. The moisture content of F1, F2, and F3 varied depending on the percentage of date palm flesh added: 10%, 15%, or 20%, respectively. All formulations had significantly different moisture contents ($P > 0.05$). Each percentage increase in date flesh resulted in a decrease in moisture content. The formulation derived from this study suggests that products with high energy will have a low moisture

content since the moisture content of a product decreases as its density and energy content increase [32]. Products with a low moisture content will be more decay-resistant and have a longer shelf life [33].

All date milk formulations contain between 0.77 g/100g and 0.98 g/100g of ash. F2 has the highest ash content (0.83 g/100g) of the three date flesh addition varieties, while F1 has the lowest (0.77 g/100g). The ash content was significantly different between F0 and F1 (P 0.05), while it was not significantly different between the other formulations (P > 0.05). Ash content can indicate the mineral composition of a food ingredient [34]. There is a correlation between a food constituent's water content and mineral content; a high-water content will reduce the mineral content because minerals dissolve in water [35]. This study demonstrates this by F1 exhibiting the highest and lowest water and ash content values, respectively.

The highest fat content was found in F3 (5.21 gr/100g) and the lowest in F0 (3.68 g/100g). The difference in fat content between formulations was not statistically significant (P > 0.05). Adding 20% date flesh (F3), the formulation contained the most-fat (5.21g/100g). This product is anticipated to have a high fat content because a date milk drink fortified with vitamin D will be used as an alternative growth-promoting diet for preschoolers. The recommended fat adequacy level for preschool children aged 4 to 6 years old is 50 grams daily [36]. Fat is a source of energy and essential nutrients for growth because fat-soluble vitamins A, D, E, and K require fat for metabolism [37].

This study showed that the protein content of the control group (F0) was 3.20 g/100 g higher than the protein content of the three-date milk formula. F3 has the lowest protein content, 2.42 g/100 g, because it contains the most water. The refining time and temperature also affect the protein content of foods. The decrease in protein content in the F3 formula was probably caused by the pasteurization temperature, which was higher than specified, namely 75°C. This result is in line with the research by Deana and colleagues, which indicated that a decrease in protein levels in Nagara bean probiotic beverage resulted from temperature fluctuations during the pasteurization process, precisely 70-90 °C for 20 minutes [38]. Temperature and time during

heating-based processing, such as cooking, sterilization, and dehydrating, should not be excessive; a single boiling point is sufficient, as excessively high temperatures result in denaturation [39].

High protein content in a food product is required because protein is a nutrient with multiple benefits, including serving as an energy source, building cells, and assisting intracellular and glucose metabolism [40]. Protein is also necessary for tissue synthesis, bone growth, and maintaining body functions, all of which contribute to growth [41]. Long-term protein deficiency can lead to energy and protein deficiencies and malnutrition, exacerbating micronutrient deficiencies such as vitamin A and iron [42].

Formula F3 (20% date flesh) contained the highest concentration of carbohydrates among all formulations at 14.27 g/100 g, while F0 (control) had the least at 9.35 g/100 g. The difference in carbohydrate content between F0 and F1 was not statistically significant (P > 0.05), whereas the other formulations were significantly different (P < 0.05). In this study, the percentage of dates added to liquid milk was directly proportional to the measured carbohydrate content of each formula; the greater the rate of dates added, the greater the carbohydrate content of the recipe. The carbohydrate content of each formula is affected by using Sukkari dates as an ingredient. Sukkari date flesh contains 78.32 g/100 g of carbohydrates [31].

Carbohydrates are monosaccharides, disaccharides, and polysaccharides derived from aldehydes. Carbohydrates are crucial in determining food constituents' flavour, colour and texture [43]. Due to the presence of carbon elements that cells can directly utilize, starch, sugar and glycogen are carbohydrates that can be used as energy sources [44]. Carbohydrates in the body metabolize fats and proteins, prevent the development of ketosis, and avert loss of minerals along with excessive breakdown of body proteins [45].

3.2 Micronutrient profile of date milk enriched-vitamin D

Table 3 presents the micronutrient content (calcium, iron, zinc, and vitamin D). The date milk formulation contains more calcium, iron, and zinc than F0 (100% liquid milk). The formulations of date milk with the highest calcium and zinc content were F3 (20% date flesh) and F1 (10% date flesh), while F2 (15% date flesh) had the highest iron content. There was a significant difference in the calcium, iron, and zinc content between F0 and F1, F2 and F3 (P < 0.05). However, there was no significant difference between F1, F2, and F3 (P > 0.05). To obtain a vitamin D content of 600 IU per 200 ml serving size, vitamin D content analysis was performed until the average vitamin D content in each formula reached 8.27 mcg per 100 ml of beverage. The measure of fortification in each date milk formula was 4 millilitres per 200 millilitres. Because Formula F0 was not fortified with vitamin D, it was not tested for its presence.

Tabel 3 Micronutrient profile of date milk enriched-vitamin D

Parameters (units)	Formulas			
	F0	F1	F2	F3
Calcium (mg/100g)	114.50 ± 5.19^{a}	213.60 ± 21.44^{bA}	217.20 ± 21.44^{cA}	223.52 ± 28.74^{dA}
Iron (mg/100g)	0.05 ± 0.00^{a}	2.38 ± 0.45^{bA}	2.48 ± 0.12^{cA}	2.42 ± 0.12^{dA}
Zinc (mg/100g)	0.39 ± 0.00^{a}	1.81 ± 0.12^{bA}	1.82 ± 0.08^{cA}	2.03 ± 0.22^{dA}
Vitamin D (µg/100g)	-	8.27 ± 1.78^{a}	8.27 ± 1.78^{a}	8.27 ± 1.78^{a}

Note: Values are mean ± SD. F1 = 10% date flesh; F2 = 15% date flesh; F3 = 20% date flesh; F0 = control (100% liquid milk). Different superscripts within the same row indicated significant differences ($p < 0.05$).

Adding date flesh enhanced the concentration of zinc, iron and calcium in all formulations of date milk. The formula contains more zinc, iron, and calcium as the percentage of date flesh added increases. The addition of date flesh enhances the zinc, iron, and calcium content of all formulations of date milk enriched with vitamin D. The content of zinc, iron, and calcium in Sukkari dates is quite high, specifically 1.07 mg/100g zinc, 6.50 mg /100g iron, and 186.55 mg/100g calcium [46] [47].

3.3 Sensory evaluation of date milk enriched-vitamin D

The detailed results of the sensory assessment, including colour, aroma, viscosity, flavour, mouthfeel, aftertaste, and overall acceptability, are shown in Table 4.

Table 4 Sensory evaluation of date milk enriched with vitamin D

Attributes	Formulas			
	F0	F1	F2	F3
Colour	6.40 ± 0.49^{a}	6.20 ± 0.80^{a}	5.83 ± 0.91^{ab}	5.53 ± 1.10^{b} 5.17
Aroma	4.80 ± 1.18^{a}	4.90 ± 1.21^{a}	5.60 ± 1.10^{ab}	$\pm 1.20^{a}$
Viscosity	5.00 ± 1.11^{a}	5.40 ± 1.30^{a}	5.37 ± 1.09^{a}	4.77 ± 1.50^{a}
Flavor	4.80 ± 1.18^{a}	4.93 ± 1.76^{a}	5.90 ± 1.02^{b}	5.50 ± 1.35^{ab}
Mouthfeel	4.80 ± 1.18^{a}	5.10 ± 1.26^{a}	5.60 ± 0.93^{ab}	5.53 ± 1.10^{a}
Aftertaste	4.80 ± 1.18^{a}	5.00 ± 1.39^{a}	5.50 ± 1.10^{a}	5.10 ± 1.37^{a}
Overall acceptability	5.20 ± 1.18^{a}	5.27 ± 1.38^{a}	5.70 ± 0.95^{a}	5.53 ± 1.07^{a}

Note: Values are mean ± SD. F1 = 10% date flesh; F2 = 15% date flesh; F3 = 20% date flesh; F0 = control (100% liquid milk). Different superscripts within the same row indicated significant differences ($p < 0.05$).

The colour sensory evaluation value ranged from 5.50 to 6.40 in the formulation of date milk enriched with vitamin D. The colour attribute for F3 was significantly different from F0 and F1 ($P < 0.05$) but not significantly different from the other formulations ($P > 0.05$). The panellists preferred the colour F0 because it had a more vibrant hue compared to F1, F2, and F3. This colour difference was determined by the percentage of date flesh added to liquid milk; the greater the percentage of date flesh added, the darker the resulting product. Dates with a Tamar maturity level, known as dry dates, are used to formulate this formula. At this stage of maturity, the dates are extremely ripe and their colour changes from brown to black [47]. Dates' sensory properties can be affected by phytochemical components such as phenolics, anthocyanins, sterols, carotenoids, flavonoids, and procyanidins. Anthocyanin levels are directly proportional to the colour of the dates, with very high anthocyanin levels on fresh dates and decreasing anthocyanin levels on desiccated dates [48].

The range of values for the aroma and mouthfeel attributes was 4.80 to 5.60, and the range for the flavour attributes was 4.80 to 5.90. Formula F2 had the highest score for aroma, flavour, and texture among formulations of date milk enriched with vitamin D. There were significant differences in aroma, flavour, and mouthfeel between the F2 formulation and the control group ($P < 0.05$), but no significant difference between the date milk formulations ($P > 0.05$). F2 is preferred over F1 and F3 because its sweetness and fresh fragrance are just right, its flavour is neither too sweet nor bland, and its mouthfeel is neither too thick, too runny, nor gritty.

Dates contain volatile compounds that, depending on the type of fruit and the maturity stage, account for 90.7-99.6% of the total aroma profile [49]. Date fruit used as a flavour enhancer in date milk drinks fortified with vitamin D contains a variety of sugars, including monosaccharides (glucose 51.80 g/100 g and fructose 47.50 g/100 g) and disaccharides (sucrose 3.20 g/100 g). Sukkari dates, used as a beverage ingredient, contain more glucose-fructose than other date varieties, such as Deglet-Nour and Allig [46]. During processing, the date pulp is filtered twice, following the blending of liquid milk and date fruit flesh, and also before filling packaged vessels with date milk drink. This procedure attempts to reduce the grittiness and stringiness of the beverage.

In this study, the observed texture was the viscosity of the beverage that was being developed. The average rating of the viscosity characteristic by the panellists ranged from 4.77 to 5.40. There was no statistically significant difference ($P > 0.05$) between formulations concerning viscosity. Vitamin D-enhanced date milk beverages tend to be thicker in proportion to the amount of added date flesh. Date milk products are less preferred as their viscosity increases with the percentage of date fruit flesh added. Most consumers prefer beverages with a liquid consistency over those with a dense texture. This study is consistent with the findings of a study conducted by [50] revealed that liquid formulations are preferred because their consistency is similar to that of mineral water, which does not cause throat discomfort when the product is ingested.

The average value of the formulas for the aftertaste attribute ranges from 4.80 to 5.50, with F0 receiving the lowest score and F2 the highest. There was no significant difference between the aftertaste characteristics ($P > 0.05$). Due to the use of dates as a natural sweetener in the formulation of date milk beverages fortified with vitamin D, there is no overpowering flavour after consumption. Overall, the formulation in this study is acceptable because it has a score greater than 4 (neither like nor test) and a range of values between 5.20 and 5.70. There was no significant difference between all formulations of vitamin D-enriched

date milk (5.27–5.70) and the control (5.20) regarding overall acceptability attributes.

4. Conclusions

The results of this study revealed that the energy, fat and carbohydrate levels were highest and lowest for F3 (20%) and F0 (control), respectively. There was a significant difference in the energy value of F0 compared to F2 and F3. Among all the date milk formulations, only F1 and F3 were significantly different ($P<0.05$).

F1 exhibited the highest moisture content, and F0 the lowest, but F0 has the highest ash content compared to all the other formulations. The F2 formula has the maximum protein concentration, whereas the F3 formula has the lowest. The water content differed significantly between the formulas, while the ash content was significantly different between F0 and F1. The protein content of F0 differed significantly from that of F1 and F3, while the difference between F0 and F2 was not statistically significant. Calcium, iron, and zinc concentrations in F1, F2, and F3 were affected by the percentage of added date flesh, and were substantially different from the control group F0. All three formulations' vitamin D content (F1, F2, and F3) was identical.

Regarding aroma, flavour, mouthfeel, residue and overall acceptability, the formulation with the highest acceptability was date milk enriched with vitamin D and containing 15% date flesh (F2). In terms of colour, F0 is the preferable formula, while F1 is the most accepted formula in terms of viscosity. There was no significant difference in overall acceptability between formulations.

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