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Composite Alternative Milk
I: Evaluation of Chemical, Mineral and Vitamin Contents of the Composite Alternative Milk

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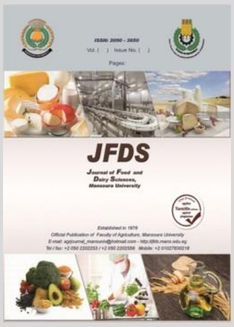

ABSTRACT

The aim of this research is to reach the composite of alternative milks which were previously studied by the same authors in order to produce a palatable taste with the highest nutritional value. Coconut milk (A), potato flour milk (B), white corn milk (E), Tiger nut milk (F), sorghum milk (G), dry bean milk (H) sesame milk (I), and cantaloupe seeds milk (J) were used to make five composite alternative milks (AFG, AHJ, ABI, JBI and FBE) and evaluated by estimating the chemical, mineral and vitamin contents. Results indicated that, there were significant differences between all composite milk samples in chemical composition. Protein ranged between 3.72 % in FBE and 13.68% in JBI. ABI had the highest fat content followed by AHJ. Ash ranged between 2.12% in AHJ and 1.02% in JBI. Moisture content was the lowest in ABI. Sample AHJ had the highest amount of calcium, magnesium and sodium. The milk of AFG had higher content of potassium, copper and manganese. Composite milk which contain cantaloupe seeds, potato flour and sesame milk had a good source of vitamin D and vitamin B group.

Keywords: alternative milk, composite alternative milk, minerals, vitamins

INTRODUCTION

Coconut milk is the only plant-based milk available in the Egyptian market for people who suffer from lactose and casein intolerance, El-Bialy *et al.* (2020) used coconut milk as a control sample and compared it to other plant-based milk alternatives. Non-dairy or plant-based milk substitutes are among the beverage categories with the fastest global growth. Lactose intolerance is one of the main causes. These dairy alternatives are naturally lactose-free and contain less cholesterol and fat than milk from animals. These alternatives advantage persons who do not have lactose sensitivity because they are frequently easier to digest than dairy products (Pandey and Poonia, 2020; Domke, 2018; Flom and Sicherer, 2019). Plant-based milk alternatives have become more and more popular recently, yet consumer perception of these goods is still largely studied (Adamczyk *et al*., 2022). Plant-based milk produced by breaking down the raw plant material to make it tiny, extracting the water, and homogenizing the mixture. Cereals, leguminous plants, nuts, seeds, and pseudo-cereals are among the categories of raw materials that are employed (Silva *et al*., 2022). The nutritional content depends on the plant source and further fortification. These alternatives milk are produced by extracting the tested plant material in water, isolating the liquid, and combining it with the final formulation.

Nuts, grains, and seeds are used to create inventive drinks. In order to create these alternatives, plant material is extracted in water, the liquid is separated, and then the finished product is created. To increase the suspension and microbiological stabilities of commercial products that may be ingested as-is or subsequently processed into fermented dairy-type products, homogenization and thermal treatments are required. The amount of nutrients depends on the plant source and any further fortification. (Pandey and Poonia, 2020). Most nut beverages also contain carrageenan, a thickening agent, to give the liquid a milk-like mouth feel. Other non-dairy beverages, like almond and rice beverages, are now widely accessible as milk substitutes. These drinks are frequently promoted as being healthier than cow's milk. These drinks are not nutritionally similar to milk, even though they can be a part of a healthy diet, include specific nutrients, and may be a better option than other drinks (like soda). But these two types of milk alternatives are expensive and not available in developing countries (Lewin, 2012).

Plant-based products include less calcium, phosphorus, magnesium, potassium, and sodium than dairy, as well as vitamins D and B12 (Craig and Brothers, 2021; Tan and McClements, 2021 and Bridges, 2018). As a result, plant-based dairy replacements are frequently fortified to deliver the highest amount of nutrients (Bridges, 2018). In addition to the actual nutritional features of plant-based dairy replacements, customers' perceptions of this product category are critical (Yang and Dharmasena, 2020).

The objective of this study was to achieve a nutritional balance of alternative milk mixtures and functionally active ingredients with health-promoting properties which attract health-conscious consumers.

MATERIALS AND METHODS

Materials

Tiger nuts (*Cyperus esculentus*), cantaloupe seeds (*Cucumis melo L.*) and grated coconut (*Cocos nucifera*)

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were obtained from local markets in Tanta, AL-Gharbia, Egypt. White sesame seeds (*Sesamum indicum L.*) Shandaweel 3, dry corn grain (*Zea mays L.*) white variety (hybrid singles 10), sorghum grains (*Sorghum bicolor L.*) and dry bean seeds (*Phaseolus lunatus L.*) were received from the Filed Crops Institute, Agricultural Research Centre, Giza, Egypt. Potato powder (*Solanum tuberosum*) was obtained from Tayiba Food Industries Company, Burj Al Arab in Alexandria, Egypt.

Methods

Preparation of alternative milk

Tiger nut, sesame seeds, corn grain, sorghum grain, and dried bean seeds were cleaned to remove extraneous elements and bad/cracked nuts and seeds before being washed and rinsed with portable water. Cantaloupe seeds were extracted from the fruit, gently rinsed with tap water, placed in a perforated basket to drain the water, and sun dried. Dried cantaloupe seeds were oven dried at 50°C for 20 minutes (El-Bialy *et al.,* 2020).

The dried shredded coconut was combined with water in a 1:5 (w/v) ratio and left to hydrate in the refrigerator (4°C) for 12 hours. Hydrated coconut was heated in a water bath at 65-75°C for 10 minutes Belewu *et al.* (2013) with a few adjustments. Potato powder was mixed with water at a 1:13 (w/v) ratio and left to hydrate in the refrigerator (4°C) for 12 hours before heating to 45-60°C in a water bath for 10 minutes.

A lab hammer mill was used to grind white maize grain into fine flour, or whole meal flour. Corn flour and water were combined at a ratio of 1:16 (w/v) and left to hydrate in the refrigerator for six hours (Manzoor, 2017). The mixture was then cooked in a water bath for ten minutes at a temperature of between 75 and 80°C .

Tiger nuts, sorghum, and beans of known weights were soaked in tap water for 12 hours and then refrigerated. Tiger nut, sorghum, and bean soaked water were taken out. Water was combined with tiger nuts, sorghum, and beans in the following ratios: 1:6, 1:7, and 1:5 (w/v) (Sanni *et al.*, 1999; Awonorin and Udeozor, 2014). The mixture was then blended, with the tiger nuts and sorghum being heated to 80°C for 10 minutes and the bean for 30 minutes. According to Bastıoğlu *et al.* (2016), sesame and cantaloupe seeds were pulverized using an electric blender. The ground seeds were mixed with water in 1:5 and 1:10 (w/v) ratios for sesame and cantaloupe, respectively, and boiled in a water bath at 80-85°C for 30 minutes (Akubor and Ogbadu, 2003).

Composite alternative milks

The best alternative milk which recorded high scores of sensory characteristics (coconut, sesame seeds, cantaloupe seeds and tiger nut milk) from our previous studied were chosen for making the composite alternative milks, as the base of the mixture in order to increase the level of acceptance as shown in (Table 1).

Table 1. Different formula of composite alternative milks

Milk samples, ml	Coconut milk (A)	Potato flour milk (B)	White corn milk (E)	Tiger nut milk (F)	Sorghum milk (G)	Dry bean milk (H)	Sesame milk (I)	Cantaloupe seeds milk (J)
AFG	50	-	-	25	25	-	-	-
AHJ	50	-	-	-	-	25	-	25
ABI	50	25	-	-	-	-	25	-
JBI	-	25	-	-	-	-	25	50
FBE	-	25	25	50	-	-	-	-

Chemical analysis

The moisture, crude protein, crude fat, and ash content in raw materials were determined using the method provided by A.O.A.C. (2010). The total fat of alternative milk was measured in accordance with James (1995). Onivogui *et al.* (2014) determined total carbohydrate content (dry weight basis) using the difference method. The energy value of alternative milk was evaluated using the approach provided by Hunt *et al.* (1987).

The mineral content of alternative milk samples was assessed using the dry ash extraction method outlined by James (1995) for each specific mineral element. The experiments were carried out at the Agricultural Research Center in Giza, Egypt.

Determination of vitamin B group

HPLC analysis was carried out using an Agilent 1260 series. The separation was carried out using Kromasil 100-5-C18 (4.6 mm x 250 mm i.d., 5 μm). The mobile phase consisted of water with 0.01% TFA (pH 2.9) (A) and Methanol (B) at a flow rate 1 ml/min. The mobile phase was programmed in case of vitamin B group (B1, B2, B6, B9 and B12) of composite alternative milk samples consecutively in a linear gradient and the injection volume was 10 uL. The multi-wavelength detector was monitored at 280 nm according to the method described by Plaza *et al*. (2006).

Determination of fat soluble vitamins

HPLC in case of the fat-soluble vitamins A, E and D of composite alternative milk samples the column used was Agilent C18 (4.6 mm x 100 mm i.d., 3.5 μm). The mobile phase was methanol: acetonitrile 65:35 and the flow rate was 1 mL/min. The injection volume was 20 μl for each of the sample solutions. The DAD was adjusted at 295 nm. The column temperature was maintained at 35°C according to the method described by Katsa *et al.* (2016).

Statistical analysis

Gomez and Gomez's (1984) method was used for variance analysis. Duncan's (1955) method was used to compare the treatment means. The significance threshold was merely 0.05.

RESULTS AND DISCUSSION

Results

Chemical composition of composite alternative milk samples

The chemical compositions of composite alternative milk are shown in Table 2. Data indicated that, there were significant differences ($p<0.05$) among all composite alternative milk samples in nutritional compositions on dry weight basis. Protein content ranged between 3.72 % in sample FBE and 13.68% in sample JBI.

Sample ABI had the highest fat content; it was 35.47% on dry weight basis followed by sample AHJ (26.84%). Meanwhile sample FBE recorded the lowest percentage of fat (3.69%). Table 2 illustrated that; sample AHJ recorded a good amount of ash (2.12%) than other composite alternative milk samples.

Table 2. Chemical composition of composite alternative milk samples on dry weight basis

Composite alternative milk samples	Protein, %	Fat, %	Ash, %	Carbohydrate, %	Energy value, kcal/100g	Total solids, %	Moisture, %
AFG	5.69[d]	23.72[c]	1.66[b]	68.93[b]	511.96[c]	12.20[b]	87.80[d]
AHJ	8.50[b]	26.84[b]	2.12[a]	62.54[c]	525.72[b]	11.41[c]	88.59[c]
ABI	6.49[c]	35.47[a]	1.42[b]	56.62[d]	571.67[a]	14.33[a]	85.67[e]
JBI	13.68[a]	22.68[d]	1.02[c]	62.62[c]	509.32[d]	9.87[d]	90.13[b]
FBE	3.72[e]	3.69[e]	1.28[bc]	91.31[a]	413.33[e]	8.88[e]	91.12[a]

In a column, means having the same superscript letters are not significantly different at 5% level.
A= Coconut milk, B= Potato milk, E = White corn milk, F = Tiger nut milk, G= Sorghum milk, H = Dry bean milk, I= Sesame milk, J = Cantaloupe milk.

The milk of sample FBE reported 91.31% carbohydrate; it was higher than other composite alternative milk samples (Table 2). Data also showed that, energy ranged between 571.67 kcal/100g in sample ABI and 413.33 kcal/100g in sample FBE. The lowest percentage of moisture is offset by the highest percentage of total solids, so sample ABI is higher in total solids (14.33%). Moisture contents ranged between 85.67% in sample ABI and 91.12% in sample FBE.

Minerals contents of composite alternative milk samples

Minerals contents of composite alternative milk were presented in Table 3. Data indicated that, sample AHJ had the highest content of macro-elements i.e.; calcium (14.82 mg/100g), magnesium (142.63 mg/100g) and sodium (6.40 mg/100g) compared with other alternative milk samples. Meanwhile, sample JBI recorded the high amount in phosphorus; it was 32.68 mg/100g.

Results also revealed that 100g of the AFG sample contained enough K for children between the ages of 0 and 6 months. The milk of samples JBI and FBE had K nearly the needs for the age of 0–6 months. Likewise samples AHJ and ABI had K less than recommended daily nutrient intake for infants and children. The milk of sample AHJ had Cu lower than recommended nutrient intake for infants and children. Based on the results, other samples were rich in Cu and exceed the infant and children needs for all age (Table 3).

Zinc in sample JBI was higher than recommended daily nutrient intake for infants from 0–6 months, in contrast other samples AFG, AHJ and ABI which recorded Zn lower than recommended daily nutrient intake for infants and children.

On the other hand, all eight composite alternative milk had good amount of Mn. When comparing the results with the recommendations, it was found that samples AHJ, ABI and FBE had Mn more than recommended nutrient intake from 0–6 months. The milk of sample AFG had more Mn than recommended from 1–3 years and nearly the needs of infants for age 4–8 years.

It could be noticed from the same table that, all five composite alternative milk were poor in minerals (Ca, Na, P and Fe) and lower than the infants and children recommended daily nutrient intake pattern (NCCFN, 2017) for all age children groups. In contrast all composite alternative milk samples had Se more than recommended nutrient intake for all infants and children.

Table 3. Minerals contents (mg/100g) of composite alternative milk samples

Composite alternative milk samples	Macro-elements					Micro-elements				
	Ca	P	Mg	Na	K	Cu	Zn	Mn	Fe	Se
AFG	6.70	20.68	90.03	6.23	436.18	8.32	1.89	1.42	0.78	1.96
AHJ	14.82	24.73	142.63	6.40	103.02	0.08	0.22	0.21	0.78	0.17
ABI	14.80	16.58	106.12	6.36	76.11	0.12	0.25	0.16	0.57	0.19
JBI	8.85	32.68	131.49	5.53	299.75	0.98	3.39	0.91	0.53	1.96
FBE	6.07	15.89	55.84	5.56	252.09	0.79	2.11	0.39	1.27	1.79
Recommended nutrient intake for infants and children, mg/day										
0–6 months	250	100	30	120	400	0.2	2.8	0.003	*a*	0.006
7–12 months	260	275	75	370	700	0.22	4.1	0.6	11	0.010
1–3 years	700	460	80	1000	3000	0.34	4.2	1.2	7	0.017
4–8 years	1000	500	130	1200	3800	0.44	5.2	1.5	10	0.021

a **=Neonatal iron stores are sufficient to meet the iron requirement for the first six months in full term infants.**
A = Coconut milk, B= Potato milk, E = White corn milk, F = Tiger nut milk, G= Sorghum milk, H = Dry bean milk, I= Sesame milk, J = Cantaloupe milk.

The milk of sample AFG reported 436.18 mg/100g potassium, 8.32 mg/100g copper and 1.42 mg/100g manganese. It was higher than other composite alternative milk samples. Based on the result sample AFG and JBI had selenium higher than other sample (1.96 mg/100g). It could be seen from the same Table that, iron content ranged between 0.53 mg/100g in sample JBI and 1.27 mg/100g in sample FBE (Table 3).

The comparison of macro-elements and micro-elements of composite alternative milk to National Coordinating Committee on Food and Nutrition (NCCFN, 2017) showed in Table 3. It could be clearly noticed that, 100 g of AHJ and JBI samples had Mg higher than the infants and children recommended daily nutrient intake pattern (NCCFN, 2017) for all age children groups. One hundred gram of AHJ and JBI cover the infant's need of age 4-8 years.

Also 100 g of AFG and ABI samples had Mg more than needs of infants for age 1–3 years while less than needs for age 4–8 years. The milk of sample FBE had Mg more than needs for recommended nutrient intake for age 0–6 months.

Vitamin B complex content in composite alternative milk samples

Vitamin B complex (B1, B2, B6, B9 and B12) was shown in Table 4. One hundred milliliter serving of the composite alternative milk samples was comparative to recommended nutrient intake (RNI) for different groups of age children.

Data in Table 4 noticed that, 100 ml serving from all samples of composite alternative milk samples had a good amount of Vit.B9 (Folate). Based on the result samples AHJ, ABI and JBI had Vit.B9 higher than RNI for infants and children. Sample AFG was more Folate than infants needs for age 0–6 and 7–12 months; the same sample (AFG) was less than needs for age 1–3 years.

One hundred ml of milk samples AFG, ABI and JBI had Vit. B6 (Pyridoxine) higher than daily recommended nutrient intake for all groups of infants and children. The sample AHJ was sufficient for the needs of infants for age 0–6 months. Also sample FBE exceed the infant needs for age 0–6 months and was less than needs for infants from 7–12 months (Table 4).

The 100 ml of samples AFG, JBI, and FBE had vitamin B1 (thiamin) lower than RNI for infants and children. The thiamin content in 100 ml of samples AFG, JBI, and FBE was lower than RNI for infants and children .Children from one to three years need 0.5 mg thiamine daily (Table 4), so; 100 ml serving of samples AFG and FBE contained approximately 16.6% of the RNI for thiamin. But Sample JBI contained 22.2% of the RNI for thiamin. Meanwhile samples AHJ and ABI had no thiamin content.

One hundred ml of sample ABI meet the need of vitamin B2 (riboflavin) for infants from one to three years. Samples JBI and FBE recorded enough Vit.B2 for infants from 7–12 months. Likewise sample AHJ was sufficient for the needs of infants from 0–6 months. Meanwhile, 100 ml of sample AFG contained two thirds of the needs for infants from 0–6 months for Vit.B2.

Table 4. Vitamin B complex in composite alternative milk samples compared to RNI*

composite alternative milk samples	Thiamine (B1), mg/100 ml	Riboflavine (B2), mg/100 ml	Pyridoxine (B6), mg/100 ml	Folates (B9), µg/100ml	Cobalamine (B12), µg/100ml
AFG	0.083	0.205	28.884	119	410
AHJ	ND	0.295	0.109	491	2531
ABI	ND	0.495	12.420	924	931
JBI	0.111	0.359	11.248	633	349
FBE	0.088	0.443	0.226	159	592
Recommended nutrient intake for infants and children					
	mg/day	mg/day	mg/day	µg/day	µg/day
0–6 months	0.2	0.3	0.1	80	0.4
7–12 months	0.3	0.4	0.3	80	0.7
1–3 years	0.5	0.5	0.5	150	0.9
4–6 years	0.6	0.6	0.6	200	1.2
7–9 years	0.9	0.9	1.0	300	1.8

*** RNI = Recommended nutrient intake (FAO/WHO, 2004), ND = Not Detected**
A= Coconut milk, B= Potato milk, E = White corn milk, F = Tiger nut milk, G= Sorghum milk, H = Dry bean milk, I= Sesame milk, J = Cantaloupe milk.

Fat-soluble vitamins content in composite alternative milk samples

The fat-soluble vitamins in the five samples of composite alternative milk were determined in this study. Sample AHJ had the fat soluble vitamins A, D and E compared with the other four samples as shown in Table 5. Also, the same Table showed the comparison of fat soluble vitamins in composite alternative milk with National Coordinating Committee on Food and Nutrition (NCCFN, 2017). The value indicated that, One hundred ml of sample AHJ contained Vit. A approximately one third of the requirements for infants from 0–6 months. Meanwhile the other samples had no vitamin A.

The data in Table 5 showed that, sample AHJ was rich in vitamin D. One hundred ml of sample AHJ had vitamin D higher than the recommended daily nutrient intake pattern NCCFN (2017) for all age children groups. The 100 ml milk of sample JBI had vitamin D nearly for the needs of infants of 0–6 and 7–12 months groups. Meanwhile sample ABI had Vit.D more than half of the requirements for 0–6 and 7–12 months, in contrast sample AFG had vitamin D less than recommended daily nutrient intake for all age children groups. The milk of sample FBE had no vitamin D.

From the same Table, data illustrated that, 100 ml samples AFG, AHJ and FBE had vitamin E less than recommended nutrient intake for all age children groups. Meanwhile samples ABI and JBI had no vitamin E.

Table 5. Fat-soluble vitamins (µg/100mL) in composite alternative milk samples compared to NCCFN (2017)

composite alternative milk samples	Vit. A	Vit. D	Vit. E
AFG	ND	0.69	2.11
AHJ	112.65	17.34	4.45
ABI	ND	6.80	ND
JBI	ND	9.76	ND
FBE	ND	ND	2.65
Recommended nutrient intake for infants and children			
	µg /day	µg /day	mg/day
0–6 months	375	10	3
7–12 months	400	10	3
1–3 years	400	15	5
4–6 years	450	15	5
7–9 years	500	15	7

ND = Not Detected A= Coconut milk, B= Potato milk, E = White corn milk, F = Tiger nut milk, G= Sorghum milk, H = Dry bean milk, I= Sesame milk, J = Cantaloupe milk.

Discussion

The high protein content of sample JBI might have been influenced by the high protein content of cantaloupe and sesame seed milk. According to El-Bialy *et al.* (2020), the sample's ABI, AHJ and AFG high fat content may have resulted from coconut milk's greater fat content. The FBE sample's low fat content could be attributed to the lack of fat in potato flour and corn milk (El-Bialy *et al*., 2020).

Ash content measures the amount of essential nutrients for human health and mineral components in food (Onyeka, 2008). Comparatively speaking to other samples, sample AHJ detected a significant amount of ash. As shown by El-Bialy *et al.* (2020), it's possible that dry bean and cantaloupe seed milk contain ash more than other alternative milks. The milk beverage's ash concentration, according to Adedokun *et al.* (2014), was below the 5% legal limit.

Comparatively to other composite alternative milk samples, sample FBE contains more carbohydrates. El-Bialy *et al.* (2020) speculate that this may be due to the high carbohydrate content of milk made from corn and milk made from potato flour.

Adedokun *et al.* (2014) stated that a mixture of milk beverage manufactured from bambaranut, tigernut, and coconut contained 81.04-81.22% moisture, in contrast to Awonorin and Udeozor's (2014) observed that the moisture levels of tigernut-soy milk extract ranged between 81.71 and 86.41%. The use of different extraction methods and blending ratios for mixed milk beverages may be the root of the variation in moisture content (Adedokun *et al*., 2014).

Inorganic elements called minerals are present in body fluids and tissues. Sodium, potassium, calcium, phosphorus, magnesium, and sulphur are necessary macrominerals, whereas zinc, copper, selenium, molybdenum, fluorine, cobalt, chromium, and iodine are microminerals. These are essential for the blood, soft tissues, skin, hair, and nails to remain healthy and intact. Additionally, they regulate fluid balance, nerve cell transmission, blood clotting, hormone and enzyme activity, and acid/base balance (Soetan *et al*., 2010).

When compared to other composite alternative milk samples, sample AHJ exhibited the highest content of the macro-elements calcium, magnesium, and sodium. According to El-Bialy *et al.* (2020) coconut milk, dry bean, and cantaloupe seeds milk had good amounts of Na whereas cantaloupe seeds milk had a high level of macro-elements (Ca and Mg). Meanwhile, sample JBI showed high phosphorus content. Milk made from sesame and cantaloupe seeds was very high in phosphorus (El-Bialy *et al*., 2020). Phosphorus is always found in the body with calcium contributing to the blood low Ca/P facilitates calcination in the small intestine (Nieman *et al*., 1992).

Manganese plays a crucial part in the transmission of oxygen from the lungs to cells and the activation of enzymes involved in glucose, lipid, and protein metabolism (Payne, 1990). Nonetheless, all five composite alternative milks contained a healthy level of Mn. The samples AHJ, ABI, and FBE exhibited Mn intakes from 0 to 6 months that were higher than indicated when the data were compared to the guidelines. The amount of Mn in the milk from sample AFG was almost as much as what infants between the ages of 4 and 8 needed.

The ARI advises adults to consume a maximum of 400 mg of magnesium per day, or 3 to 4 mg per pound of body weight. For example, in addition to his high dose of B6, a 35-pound toddler would take 105 to 140 mg of magnesium per day. Only when combined with magnesium could high dosages of vitamin B6 reduce the symptoms of autism (Strickland, 2009).

Mg levels in 100 g of the AHJ and JBI samples were greater than those suggested by the NCCFN (2017) for all age groups of infants and children for daily nutritional consumption. Moreover, 100 g of AFG and ABI samples is more than what is required for infants from ages 1-3 but less than what is required for children from ages 4 to 8. The milk from sample FBE contained more magnesium than is recommended for infant ages 0 to 6 months.

Because vitamins are essential for human health, growth, development, reproduction, and maintenance, vitamin deficiencies are posing serious health risks. The human body's energy metabolism and cardiovascular function depend on cobalamin, a form of vitamin B12. Vitamin B12 is involved in the production of red blood cells, which carry oxygen throughout the bloodstream, with the help of the haemoglobin pigment (Maqbool *et al*., 2018).

The role of folates is to support brain health, and they have a relationship with neurotransmitters, particularly serotonin and dopamine, according to Crider *et al.* (2011). Folates support the cardiovascular and neurological systems in humans.

Vitamin B6 has been identified as a potential treatment for autism due to its significance in neurological function. Vitamin B6, a water-soluble vitamin, is required for the manufacture of two important neurotransmitters in the brain: serotonin and dopamine. A high dose of vitamin B6 is effectively used as a "medication" to enhance the brain's natural production of serotonin and dopamine. This cerebral link could be the reason why it helps certain autistic children's symptoms (Strickland, 2009).

Pyridoxine (Vitamin B6) levels in 100 ml of milk samples AFG, ABI, and JBI exceeded the daily recommendations for all groups of infants and children. The demands of infants between the ages of 0 and 6 months might be met by the sample AHJ. Moreover, the sample FBE exceeded newborn needs for ages 0 to 6 months and fell short of those for ages 7 to 12 months. B6 is a crucial vitamin since it plays a role in the creation of red blood cells, glucose metabolism, liver detoxification, and the health of the brain and nervous system (Combs, 2007).

The RDA and UL established by the USDA Food and Nutrition Board are both exceeded by the amount of vitamin B6 that health professionals advise consuming. B6 dosages can be as high as 1,000 mg per day or as low as 200 mg.

In this study, a sample of 100 ml AFG met two-thirds of the vitamin B2 requirements for infants from 0 to 6 months. The most significant antioxidant, glutathione, protects the body against oxidative damage. Vitamin B2 helps the body recycle glutathione. A water-soluble vitamin called riboflavin functions as an enzyme cofactor in processes that transfer electrons. A lack of this vitamin increases the risk of anaemia because it enhances the metabolism of iron (Öste *et al*., 1997; Maqbool *et al*., 2018).

The body needs a tiny amount of fat-soluble vitamins to remain healthy. To be healthy and function effectively on all fronts, including the immune system, muscle and heart health, blood flow and clotting, and eye health, the body needs fat-soluble vitamins (Ravisankar *et al*., 2015).

In the current study, one-third of the vitamin A requirements for infants between the ages of 0 and 6 months were met in 100 ml of the sample AHJ. The all other samples, meanwhile, lacked vitamin A. Vitamin A is required for sustaining mucus-forming cells throughout the body as well as for night and colour vision, according to Byrd-Bredbenner *et al.* (2007).

Insufficient vitamin D intake can cause weak, thin, or misshaped bones as well as osteomalacia in adults and rickets in children. Getting adequate vitamin D in your diet, in addition to calcium, can help prevent osteoporosis (Ravisankar *et al*., 2015).

According to Bonvehi *et al.* (2000), vitamin E works as an antioxidant to prevent oxygen damage to fat in the membranes surrounding cells (including red blood cells, the heart, and muscles).

CONCLUSION

From the above study, it was concluded that, composite alternative milks especially samples AFG, AHJ and ABI which contains coconut milk, along with other types of alternative milk were more acceptable and nutritionally balanced in its content of minerals and vitamins, as well as protein and fats. Meanwhile the milk of JBI which consists of cantaloupe seeds, potato flour and sesame milk had good amounts of minerals, especially (manganese, potassium, copper, zinc and selenium) as well as vitamins B group and D. Therefore, it is recommended to be consumed by people with lactose and casein intolerance.

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اللبن النباتى البديل المركب
الجزء الأول: تقييم المحتوى الكيميائي والمعادن والفيتامينات فى اللبن النباتى البديل المركب

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الملخص

تهدف هذه الدراسة الى تجهيز لبن نباتى بديل مركب يتميز بطعم وقيمة غذائية جيدة والتى سبق دراستها من قبل نفس الباحثين. تم إعداد خمسة أنواع من اللبن النباتى البديل المركب (AFG, AHJ, ABI, JBI and FBE) بإستخدام اللبن الناتج من جوز الهند ودقيق البطاطس و الذرة البيضاء وحب العزيز والذرة الرفيعة والفاصوليا والسمسم وبذور الكنتالوب. أجريت الاختبارات الكيميائية وتقدير المعادن والفيتامينات فى اللبن النباتى البديل المركب. أوضحت النتائج وجود فروق معنوية لجميع العينات فى التركيب الكيميائى. أعلى نسبة البروتين١٣,٦٨% سجلت فى العينة JBI و أقل قيمة٣,٧٢% في العينة FBE. و كانت العينة ABI أعلى فى نسبة الدهون يليها العينة AHJ. أما نسبة الرماد تراوحت بين ٢,١٢% في العينة AHJ و ١,٠٢% في العينة JBI. أقل محتوى رطوبة سجلت في العينة ABI. العينة AHJ سجلت أعلى قيمة فى الكالسيوم والمغنيسيوم والصوديوم. أما لبن AFG سجل أعلى نسبة فى البوتاسيوم والنحاس والمنجنيز. يعتبر اللبن النباتى البديل الذي يحتوي على بذور الكنتالوب ودقيق البطاطس ولبن السمسم مصدر جيد لفيتامين د ومجموعة فيتامين ب.