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Composite Alternative Milk
II: Evaluation of Physical Properties and Microbial Count of the Composite Alternative Milk

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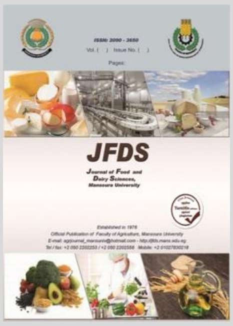

ABSTRACT

The aim of this research is to prepare acceptable casein free and lactose free high quality alternative milk which were previously studied by the same authors. 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) as shown in part I. Composite alternative milks were evaluated by physical, microbiological and sensory during storage period. Composite alternative milks had sensory qualities that were acceptable, with good nutritional content, and high quality in flavor, color, mouth feel, taste, and texture. Approximately, during storage, all samples of composite alternative milk's sensory qualities and total bacterial count were unaffected. Acidity was increased by increasing of storage period in samples with 50% tigernut milk or 50% cantaloupe seed milk. Sedimentation stability was high in samples with 50% tigernut milk or cantaloupe seed milk. The highest viscosity at 10 rpm found in sample with 50% coconut milk, 25% potato flour milk and 25% sesame milk. Samples containing 50% coconut milk have the best color, taste, flavor, texture and mouth feel.

Keywords: composite alternative milk, physical analysis, microbial analysis, sensory

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. Cow's milk has long been regarded as a staple diet due to its nutritious significance. However, due to allergies and lactose intolerance, as well as changing lifestyles, demand for plant-based milk alternatives has increased in recent years. As traditional seeds or nuts are saved from widespread misuse, additional choices are being created to give plant-based milk substitutes (Reyes-Jurado *et al*., 2023).

The beverage industries depend heavily on plant-based milk substitutes and analogues made from soy, almond, coco nut, oat, pulses and rice. The industry for plant-based milk substitutes has grown for a number of reasons, including dietary choices and dietary requirements. Additionally, plant-based milk products are highly valued since they are abundant in health-promoting bioactive, free of cholesterol and ecologically friendly because they take less energy to produce one unit of milk (Ramesh *et al.*, 2022).

The market for plant-based product is expanding quickly worldwide, and plant-based milks have a bright future in the beverage industry (Chung *et al.*, 2022). Due to rising consumer knowledge of sustainable food production, ethical considerations (animal welfare and religious practises) and the health advantages of a plant-based diet, plant-based alternative diet are becoming more and more common. (McClements *et al*., 2019).

Additionally, plant-based milks have health advantages since they lack cholesterol and hormones from cow milk and are high in dietary fibre, unsaturated fatty acids and bioactive substances like phytosterols, isoflavonoids and polyphenols. These elements collectively are fueling the market expansion for plant-based milk (Aydar *et al*., 2020).

Vaikma *et al.* (2021) discovered that the fundamental flavor characteristic of plant-based milks was connected to its particular plant source at the ingredient level. Oat, rice, buckwheat and quinoa were discovered to have a cereal flavor; almond, coconut, hazelnut, cashew and Brazil nuts were discovered to have nutty flavors; etc. Specific products were noted as having different tastes, odors and textures within these categories.

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*) 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.

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Methods

Preparation of composite alternative milk

Preparation of five composite alternative milks was described in the part I of this work. Formula of samples were presented in Table 1. Composite alternative milk samples were stored in 3 replicates sterile bottles in refrigeration (5±1°C) temperatures for 14 days.

Table 1. Different formula of composite alternative milk

Composite milk samples, ml	Coconut milk (A)	Potato flour milk (B)	White corn milk (E)	Tiger nut milk (F)	Sorghum milk (G)	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	-	-	-	-

Physical analysis

Total acidity was estimated using the proportion of lactic acid, pH value and total soluble solids as defined by A.O.A.C (2010).Specific gravity was calculated using the method provided by Omole and Ighdaro (2012). The total solid content (%) was determined using the method provided by Niveadhitha and Ramasamy (2018). The sedimentation stability of alternative milk was assessed using the Quasem *et al.* (2009) method.

Measuring of Viscosity

Viscosity of plant milk samples was measured at room temperature using a Brookfield digital viscometer (Middleboro, MA 02346, U.S.A). The sample was gently stirred 5 times in clockwise direction with a plastic spoon then placed in small sample adapter; the S-00 spindle was used. Viscosity measurements were expressed as centipoise (cp.s) at 10 rpm for all samples (Salama *et al.*, 2019).

Determination of color characteristics

The color of composite alternative milk samples was measured using a spectrocolorimeter (Tristimulus Color Machine) and the CIELAB color space (International Commission on Illumination), as described by Sapers and Douglas (1987) and Eissa *et al.* (2020). The color values were denoted as L* (lightness or brightness/darkness), a* (redness/greenness) and b* (yellowness/blueness). The Hue (H)*, Chroma (C)* and browning index (BI) were computed using Palou *et al.*'s (1999) approach. The experiments were carried out at the National Research Center in Dokki, Egypt.

Microbiological analyses

The total bacterial, mold and yeast counts of composite alternative milk were determined using the pour plate technique during the storage period (0, 7 and 14 days). 0.1 ml of the appropriate dilution was applied to nutrient agar plates. Plates were incubated at 35ºC for 48 hours and colony forming units (log cfu/ml) were estimated. To count mold and yeast, repeat the technique above with potato dextrose agar and incubate at 25ºC for 72 hours.

Sensory evaluation

Twenty randomly selected members from the Food Technology Research Institute, Agricultural Research Center, Giza, Egypt, evaluated composite alternative milk samples. Members evaluated the items based on their overall acceptability as well as sensory characteristics such as color, taste, flavor, mouth feel, texture and similarity of milk. The milk samples were served cold. The scores were based on a hedonic scale of 1 to 10, where 1 means dislike very lot and 10 means like very much (Ihekoronye and Ngoddy, 1985; Watts *et al.*, 1989).

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

Physical analysis of composite alternative milk samples

The effect of storage period on physical analysis of composite alternative milk samples on pH, acidity and TSS were presented in Table 2. The values indicated that, pH of different composite alternative milk ranged between 6.08 in sample ABI and 6.61 in sample JBI and Likewise there were no significant differences between other three samples (AFG, AHJ and ABI) for pH value at zero time. Approximately it was evident that all samples of composite alternative milk were not affected in pH value during storage for seven days at 5°C.

Data in Table 2 showed a significant difference between all samples in acidity. The highest value of acidity was found in sample AHJ (0.15%) at zero time; meanwhile sample JBI had the lowest value (0.07% as lactic acid).

Table 2. Effect of storage period on pH, acidity and TSS of composite alternative milk samples

Parameters	Storage period, day	Composite alternative milk samples				
		AFG	AHJ	ABI	JBI	FBE
pH	0	6.09^{Ac}	6.11^{Ac}	6.08^{Ac}	6.61^{Aa}	6.29^{Ab}
	4	5.72^{Ab}	5.98^{Ab}	6.01^{Ab}	6.57^{Aa}	5.35^{Bc}
	7	5.23^{Bb}	5.92^{Ab}	6.00^{Ab}	6.53^{Aa}	5.74^{Bb}
Acidity as lactic acid,%	0	0.090^{Ac}	0.150^{Aa}	0.140^{Aab}	0.070^{Bde}	0.080^{Bcd}
	4	0.091^{Aac}	0.158^{Aa}	0.140^{Aab}	0.072^{Bc}	0.085^{ABc}
	7	0.096^{Ac}	0.190^{Aa}	0.149^{Ab}	0.099^{Ac}	0.099^{Ac}
TSS, %	0	7.5^{Aa}	7.3^{Aa}	7.3^{Aa}	6.5^{Ab}	7.5^{Aa}
	4	7.5^{Aa}	6.7^{Bbc}	7.1^{Ab}	6.4^{Ac}	7.5^{Aa}
	7	7.5^{Aa}	6.0^{Cd}	7.0^{Ab}	6.0^{Ac}	7.5^{Aa}

In a row, means having the same superscript small letters are not significantly different at 5% level for different samples, In a column, means having the same superscript capital letters are not significantly different at 5% level for storage period. TSS= total soluble solid

Acidity was increased in samples JBI and FBE by increasing of storage period; in contrast there were no significant difference for samples AFG and AHJ during storage for seven days at 5°C.

Results in Table 2 showed that, four samples (AFG, AHJ, ABI and FBE) had no significant differences (p< 0.05) for TSS and higher than JBI sample. TSS values were decreased by increasing the storage time for sample AHJ. In contrast other composite alternative milk samples were not affected in TSS value during storage for seven days at 5°C.

Viscosity, specific gravity and sedimentation stability of composite alternative milk samples

Viscosity of composite alternative milk as shown in Table 3 was measured at speed 10 rpm. The viscosity of samples ranged between 14.1 cp.s in AFG and JBI samples to cp.s 240 in ABI sample.

Specific gravity of all composite alternative milk samples were not significant different among all samples, which represents from 1.025 to 1.045 g/cm^3. Means of sedimentation stability score for samples JBI and FBE were the highest followed by sample AFG.

Table 3. Viscosity, specific gravity and sedimentation stability of composite alternative milk samples

Milk samples	Milk formula, %	Viscosity, cp.s at 10 rpm	Specific gravity, g/cm^3	Sedimentation stability
AFG	50 coconut+25 tigernut + 25 sorghum	14.1	1.044^a	0.48^b
AHJ	50 coconut+25 dry bean + 25 cantaloupe	120	1.045^a	0.05^c
ABI	50 coconut+25 potato flour + 25 sesame	240	1.026^a	0.07^c
JBI	50 cantaloupe + 25 potato flour + 25 sesame	14.1	1.025^a	0.69^a
FBE	50 tigernut + 25 potato flour + 25 white corn	62.1	1.036^a	0.66^a

In a column, means having the same superscript letters are not significantly different at 5% level.

Color of composite alternative milk samples

Results in Table 4 showed the color attributes in composite alternative milk, the data indicated that, L* -value ranged between 73.98 in sample FBE and 85.98 in sample AFG. Data in Table 4 also showed that, the milk of sample AFG reported -1.28 a* -value, it was higher than other composite alternative milk samples. It could be seen from the same table that, sample FBE had the highest b* -value, it was 8.43 followed by sample JBI (8.07).

At the same Table, the milk of sample AFG had 86.32 ΔE -value followed by sample ABI (84.85). The milk of sample AFG recorded 80.35 followed by 77.15 in sample JBI for hue angle value, that indicating a yellowish color. The data in Table 4 showed that, Chroma were increased in milk samples also hue angle increased in the same samples.

In general, the yellowness (b*) and the redness (a*) values for all composite alternative milk decreased while the lightness (L*) values increased. Chroma and browning index values for all composite alternative milk was decreased by increasing ΔE values and Hue angle as seen in the same table.

Table 4. Color characteristics of composite alternative milk samples

Composite alternative milk samples	L*	a*	b*	ΔE	H*	C*	BI
AFG	85.98	-1.28	7.53	86.32	80.35	7.64	14.29
AHJ	78.65	-1.81	2.12	78.69	49.51	2.79	1.81
ABI	84.75	-1.49	3.82	84.85	68.69	4.10	5.86
JBI	81.70	-1.84	8.07	82.12	77.15	8.28	15.45
FBE	73.98	-2.06	8.43	74.49	76.20	8.68	17.73

L* = lightness (0 ≤ L ≤ 100); a*(+) = redness; a*(-) = greenness; b*(+) = yellowness; b*(-) = blueness, ΔE: Delta E, H*: Hue, C*: Chroma and BI: Browning index, 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.

Microbiological evaluation of composite alternative milk samples during storage period at 5°C

Total bacteria count

Total bacteria count of composite alternative milk samples were presented in Table 5. It could be noticed that, at zero time, no microorganisms were found. In contrast, there were significant differences in total bacterial count between all composite alternative milk samples after 7 and 14 days of storage.

Total microbial count in composite milk samples ranged between 2.90 log cfu/ml for sample JBI and 2.47 log cfu/ml for sample AHJ and FBE after 7 days of storage. Approximately it was evident that all samples of composite alternative milk were not affected in total bacterial count during storage for fourteen days at 5°C except sample FBE.

Table 5. Total bacterial count (log cfu/ml) in composite alternative milk samples during storage period at 5°C

Composite alternative milk samples	Storage period, days 0	7	14
AFG	ND	2.78^{Ba}	2.99^{Ba}
AHJ	ND	2.47^{Da}	2.84^{Da}
ABI	ND	2.69^{Ca}	2.84^{Da}
JBI	ND	2.90^{Aa}	3.04^{Ac}
FBE	ND	2.47^{Db}	2.90^{Ca}

In a raw, means having the same superscript small letters are not significantly different at 5% level for different samples. In a column, means having the same superscript capital letters are not significantly different at 5% level for storage period.

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.

Based on the result no mold and yeast count were detected for eight samples of composite alternative milk during storage period.

Sensory evaluation of composite alternative milk samples during storage period at 5°C

The sensory scores for tested five samples of composite alternative milk were presented in Table 6. According to the data, all the samples were generally acceptable. Data showed that, the milk of sample AFG had almost the highest score in all sensory attributes.

Mean score of color was the highest in composite alternative milk samples AFG, AHJ and ABI at zero time. There were significant differences between the previous three samples and the other samples (JBI and FBE) in color at zero time. Sample FBE had the lowest color score, this sample was contained 50% tiger nut milk and 25% for both potato and corn milk.

Means of taste score for samples AFG and AHJ were the highest compared with other composite alternative milk. Also, the same result for the flavor and there were no significant differences between samples AFG and AHJ.

Sample AHJ had high score of mouth feel (9.0). Sample JBI recoded the lowest score (7.5) for similarity of milk. In Table 6, sample ABI had score of texture 8.75; it was higher than other samples. Meanwhile the lowest texture score (7.65) was noted in sample FBE.

Approximately it was evident that all samples of composite alternative milk were not affected in their sensory parameters during storage for seven days at 5°C.

Table 6. Sensory evaluation of composite alternative milk samples during the storage period at 5°C

Parameters	Storage period, day	Composite alternative milk samples				
		AFG	AHJ	ABI	JBI	FBE
Color (10)	0	9.50^{Aa}	9.38^{Aab}	9.50^{Aa}	8.75^{Ab}	8.00^{Ac}
	4	9.44^{Aa}	9.21^{Aab}	9.37^{Aa}	8.64^{Ab}	7.85^{Ac}
	7	9.38^{Aa}	9.13^{Aab}	9.00^{Aab}	8.50^{Ab}	7.63^{Ac}
Taste (10)	0	8.63^{Aab}	9.00^{Aa}	8.25^{Ab}	7.55^{Ac}	8.00^{Abc}
	4	8.47^{Aa}	8.11^{Bab}	8.00^{Aab}	7.52^{Ab}	7.92^{Aab}
	7	8.00^{Aa}	7.88^{Ba}	7.75^{Aa}	7.50^{Aa}	7.75^{Aa}
Flavor (10)	0	8.75^{Aa}	8.88^{Aa}	8.50^{Aab}	8.00^{Ab}	8.00^{Ab}
	4	8.69^{Aa}	8.65^{Aa}	8.37^{Aa}	7.91^{Aa}	7.92^{Aa}
	7	8.63^{Aa}	8.38^{Aa}	8.25^{Aab}	7.75^{Ac}	7.88^{Abc}
Mouth feel (10)	0	8.63^{Aab}	9.00^{Aa}	8.25^{Ab}	8.13^{Ab}	8.25^{Ab}
	4	8.46^{Aa}	8.15^{Ba}	8.19^{Aa}	7.89^{Aa}	7.97^{Aa}
	7	8.25^{Aa}	7.88^{Bab}	8.13^{Aab}	7.75^{Aab}	7.63^{Ab}
Texture (10)	0	8.50^{Aab}	8.38^{Aab}	8.75^{Aa}	8.25^{Ab}	7.65^{Ac}
	4	8.29^{Aa}	8.38^{Aa}	8.59^{Aa}	7.98^{ABabc}	7.63^{Ab}
	7	8.00^{Aab}	8.35^{Aa}	8.25^{Aab}	7.75^{Bab}	7.60^{Ab}
Similarity of milk (10)	0	8.63^{Aa}	8.63^{Aa}	8.25^{Aab}	7.50^{Ac}	7.75^{Abc}
	4	8.47^{Aa}	8.44^{Aa}	8.10^{Aab}	7.39^{Ab}	7.68^{Ab}
	7	8.25^{Aa}	8.13^{Aab}	7.25^{Bc}	7.25^{Ac}	7.50^{Abc}

In a row, means having the same superscript small letters are not significantly different at 5% level for different samples, In a column, means having the same superscript capital letters are not significantly different at 5% level for storage period.

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

Taste and odor are the most essential food buying characteristics, and knowledge of a good and/or familiar taste increases readiness to try an unfamiliar dish most effectively. So, to get to palatable and healthy milk, composite healthy alternative milk was made which is a mixture of three types of alternative milk. When making the composite alternative milks, the best alternative milk which recorded high scores of sensory characteristics (coconut, sesame seeds, cantaloupe seeds and tiger nut milk) were chosen as the base of the mixture. In order to increase the level of acceptance and the sensory characteristics of the alternative low-sensory milk in it, the preferred alternative milk placed at 50% with different percentages of the low-sensory alternative milk.

The decrease of pH value in sample ABI could be due to the decrease of pH for potato milk as shown in El-Bialy *et al.* (2020). The pH of commercial nondairy beverages ranges from 2.1 to 7.4 (Seow and Thong, 2005). Composite alternative milk not affected in pH value during storage for seven days at 5°C. Ihekoronye and Ngoddy (1985) mentioned that, a decrease in milk pH upon storage results in souring.

The lowest acidity value of sample JBI may be due to the less acidity for both sesame and cantaloupe seeds milk as shown in El-Bialy *et al.* (2020).

Total soluble solids (TSS) and titratable acidity are important indexes for consideration of quality (Suktanarak and Teerachaichayut, 2013). TSS values were decreased by increasing the storage time for some sample AHJ. In contrast other composite alternative milk samples were not affected in TSS value during storage for seven days at 5°C. Akubor *et al.* (2002) mentioned that, at 10°C storage there were no significant changes ($p > 0.05$) in pH, soluble solids and titratable acidity of melon (*Citrullus colocynthis*) seed milk until after day 2, when a gradual decrease in total acidity was observed.

At low viscosity levels, judges believed that the milk was watery, but acceptance was greatest only when the viscosity reached normal levels (Bakshi and Smith, 1984; Vyawahare *et al.*, 2011).

As temperature increased, viscosity and density of fluid milk decreased. As fat content increased, density decreased. The influence of fat percentage on viscosity is substantially stronger at low temperatures because a liquid's viscosity is determined by intermolecular forces that limit molecular mobility. These forces depend on intermolecular spacing, which determines free volume, and are impacted by temperature fluctuations (Bakshi and Smith, 1984). McClements (2020) reported that plant-based milks' shear viscosity is determined by the concentration of particles, such as oil bodies or fat droplets.

Fat content in coconut and tigernut milk was 41.97 and 9.11%, respectively, while carbohydrate content was 50.99 and 85.46%, respectively. Cantaloupe and sesame seeds milk contained 16.25 and 26.52% fat, while carbohydrate content was 62.69 and 58.91%, respectively as shown in El-Bialy *et al*. (2020). The fat and carbohydrate content in composite alternative milk had a reverse effect on viscosity values. The variation of viscosity values may be regarded to different sources of raw plant milk, percentages of added and its chemical composition which interact within milk. Gelatinization starch play important role in viscosity which increase the viscosity of milk.

These results may be due to the rearrangement between fat and starch after gelatinization. Starch gelatinization is a process that breaks down the intermolecular connections of starch molecules in the presence of water and heat. This allows the hydrogen bonding sites (the hydroxyl hydrogen and oxygen) to engage additional water (Sobkowska, 2001). The viscosity profile and starch gelatinization temperature depend on the physicochemical properties of the starches as well as the physical environment that the starch is exposed to during gelatinization (Tester and Morrison, 1990; Noda *et al*., 1998; Jane *et al*., 1999; Sasaki *et al*., 2000; Liu *et al*., 2006; Chang and Lin, 2007). Alcântara *et al.* (2012) found that viscosity was increased by increasing fat, protein and minerals content.

The high sedimentation of sample AFG was probably due to the high sedimentation for sorghum and rice flour milk as shown in El-Bialy *et al.* (2020). The decrease of sedimentation in samples AHJ and ABI could be due to no sedimentation in coconut milk and also, no sedimentation for dry bean milk in sample AHJ, and little sedimentation in sesame milk as shown in El-Bialy *et al.* (2020).

Color is only part of the overall appearance but is probably a major quality factor in composite alternative milk. L* represents lightness, with 100 suggesting an ideal reflecting diffuser and zero denoting black. There are no numerical boundaries for a* and b* values; negative a* is green, whereas positive is red. Negative b* is blue, while positive b* is yellow (Aidoo *et al.*, 2010).

The high L* -value of sample AFG might be result of the higher L* -value of coconut milk as shown in El-Bialy *et al.* (2020). The sample's high a* -value might be result of the high a* -value of tiger nut milk as shown in El-Bialy *et al.*

(2020). Murevanhema and Jideani (2015) concluded that, exposure to high temperatures could result in darkening of the bambara groundnut milk after some time during storage.

E-values in five composite alternative milks varied. The variation in seen brightness among the plant milk samples was caused by the color difference. This was corroborated by Nti (2009), who claimed that the pigment in the seed coat was responsible for the plant milk's coloring. Enzymatic chemical reactions occurring during the hydration of the flour may also be to blame for the decreased lightness ratings.

Microbiological analysis

The main reasons limiting the shelf life of items are frequently microbial deterioration. Microbial growth-related spoilage costs manufacturers and consumers money. These losses may result from a variety of specific factors, including product packaging, sanitary manufacturing procedures and storage conditions (Saranraj and Geetha, 2012).

Total counts of aerobic mesophilic bacteria should not exceed $7.5x10^4$ (4.88 log) cfu/ml, according to Iran's National Standards (INS) recommendations for pasteurized milk (ISIRI, 2008).

The main factor reducing the shelf life of high and intermediate items is by far mould growth. According to the type of product, the season, and the processing method, losses of products due to mould spoilage range from 1 to 5 percent (Malkki and Rauha, 2000).

Sensory analysis is seen as a useful approach for addressing issues with food acceptability. It helps with product creation, quality control, and most crucially product improvement (Singh-Ackbarali and Maharaj, 2014). Some of the main elements influencing consumer choice to consume milk drinks are health, nice flavor, and smooth texture (Akusu and Emelike, 2018).

According to Makinde and Akinoso (2014), color is a crucial factor that not only conveys the acceptability of the raw materials used in preparation but also conveys information about the product's quality.

The sample's highest color in this study may be due to the addition of 50% coconut milk to these samples. Alternative coconut milk was the highest color score as shown in El-Bialy *et al.* (2020). The decrease of color score in sample FBE attributed to the decrease of color score for each tiger nut, potato and corn milk as shown in El-Bialy *et al.* (2020).

Coconut had acceptable flavor, the main volatile chemicals found in plain coconut milk were tetracontane and 2-hexanol, while molecules including heptadecane, ethanone and 1-(3-ethyloxiranyl) were present in flavored coconut milk (Kokilavani *et al*., 2017).

Mouth feel seems to be a complicated characteristic, as evidenced by the several definitions. The ISO standard "Sensory analysis-Vocabulary" defines mouth feel as "the tactile sensations perceived at the lining of the mouth, including the tongue, gums and teeth" (ISO 5492: 1992). According to McClements (2020), a consumer's initial impression of plant-based milk is typically how it looks. This kind of product should typically look milky white and have other visual characteristics that are similar to those of cow's milk.

The lowest similarity of milk for JBI could be due probably to the poor taste in potato flour and sesame milk as well as low fat content as shown in El-Bialy *et al.* (2020).

According to Belewu *et al.* (2013), the panellists' mood may have been improved by the aroma of coconut milk. As a result, coconut milk received higher ratings. It is also important to note that the linoleic acid in coconut milk can aid persons who are lactose intolerant or allergic to animal milk by boosting their immune systems.

Texture can be defined as a multimodal-sensory food characteristic. It is defined as the kinesthetic, visual, audible, and tactile manifestation of the functional and sensory characteristics of food's surface, mechanical, and structural features. According to Tauferova *et al.* (2015), this sensory quality of food is conceptualized in a variety of ways, including thickness, creaminess, crunchiness, firmness, and smoothness

The lowest texture in sample FBE could be due to the decrease of texture score for each tiger nut, potato and corn milk as shown in El-Bialy *et al.* (2020).

CONCLUSION

From the above study, it was concluded that, composite alternative milks had sensory properties acceptable, with good nutritional value, and high quality in flavor, color, mouth feel, taste and texture for consumers who avoid animal milks to ensure its foods more attractive and diversification in the diet. Approximately it was evident that all samples of composite alternative milk were not affected in total bacterial count and their sensory parameters during storage.

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اللبن النباتى البديل المركب

الجزء الثانى: تقييم الخواص الفيزيائية والعد الميكروبي فى اللبن النباتى البديل المركب

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الملخص

تهدف هذه الدراسة الى تجهيز لبن نباتى بديل مركب عالي الجودة خالي من الكازين واللاكتوز والذى سبق دراسته من قبل نفس الباحثين. أجريت الاختبارات الفيزيائية والحسية والميكروبيولوجية فى خمسة أنواع من اللبن النباتى البديل المركب خلال فترة التخزين (كما هو موضح في الجزء الأول). حيث أعطى اللبن البديل المركب أعلى قبول فى الصفات الحسية والعناصر الغذائية المطلوبة وأعلى قبول في اللون والطعم والنكهة والقوام والاحساس فى الفم. أوضحت النتائج عدم تأثر جميع عينات اللبن البديل المركب فى الصفات الحسية والعد الكلي للبكتيريا أثناء التخزين. لوحظ إرتفاع الحموضة بزيادة فترة التخزين في العينات التي تحتوي على ٥٠% لبن حب العزيز أو ٥٠% لبن بذور الكنتالوب. ثبات الراسب كان عالى في العينات التي تحتوي على ٥٠٪ لبن حب العزيز أو لبن بذور الكنتالوب. سجلت اللزوجة أعلى قيمة في العينة التي تحتوي على ٥٠% لبن جوز الهند و٢٥% لبن دقيق بطاطس و٢٥% لبن السمسم. كانت العينات التي تحتوي على ٥٠% لبن جوز الهند الأفضل فى اللون والطعم والنكهة والقوام والاحساس فى الفم.