Effect of addition white potato milk and sweet potato milk as an alternative to animal milk and an effective probiotic on the quality and nutritional characteristics of cake.

Thnaa M. H. Gouda
Assist Prof of Food Science and Nutrition, Home Economics Department, Faculty of Specific Education, Fayoum University

المجلة العلمية المحكمة لدراسات وبحوث التربية النوعية

المجلد الحادى عشر– العدد الثالث– مسلسل العدد (٢٩)– يوليو ٢٠٢٥م

رقم الإيداع بدار الكتب ٢٤٢٧٤ لسنة ٢٠١٦

ISSN-Print: 2356-8690 ISSN-Online: 2974-4423

موقع المجلة عبر بنك المعرفة المصري https://jsezu.journals.ekb.eg

البريد الإلكتروني للمجلة E-mail JSROSE@foe.zu.edu.eg

Effect of addition white potato milk and sweet potato milk as an alternative to animal milk and an effective probiotic on the quality and nutritional characteristics of cake.

Thnaa M. H. Gouda
Assist Prof of Food Science and Nutrition, Home Economics Department, Faculty of Specific Education, Fayoum University
drthnaa@yahoo.com

تاريخ الرفع ١٣-١١-٢٠٢٤م تاريخ المراجعة ١٠-١٢-٢٠٢٤م
تاريخ التحكيم ٣-١٢-٢٠٢٤م تاريخ النشر ٧-٧-٢٠٢٥م

Abstract

Plant-based milk alternatives is similar milk due to their nutritious content, bioavailability and environmental sustainability as an inexpensive alternative in developing countries or cow's milk is insufficient. Potato milk is a novel substitute, due to it is a better source of protein, vitamins and minerals. It consume as functional food due its antioxidants and phytochemicals content. This study aimed to assess the addition of white potato milk and sweet potato milk as an alternative to animal milk and an effective probiotic on the quality and nutritional characteristics of cake. Alternative milk was prepared of potato and sweet potato. Chemical, physical and sensory properties were determined. Results showed significant differences between potato milk, sweet potato milk and buffalo milk. Protein recorded (4.2 %, 9.8 % and 3.2 %). Fat and ash content had high (2.9 % and 1.1%) in potato milk compared to buffalo milk (2.1% and 0.8%). Also magnesium, potassium, zinc and iron were (41.7, 210.6, 1.8 and 0.8 mg) compared to buffalo milk (30.3, 165.9, 0.24 and 0.14 mg). Sweet potato milk had the highest values in sensory evaluation, taste, flavor and texture were (9.4, 9.7 and 9.5) compared to potato milk (7.4, 8.3 and 8.0), but color and overall acceptability values in potato milk were high results (9.4 and 8.2) compared to sweet potato milk (7.7 and 7.3). Physical properties were acceptability. **Conclusion**: Potato milk can be as a functional food, alternative milk and an effective probiotic on the quality and nutritional characteristics of cake.

Key words: Plant based milk, potato, potato milk, sweet potato milk.

الملخص العربي

يعد الحليب النباتي بديلاً مشابهاً للحليب الحيواني، نظرا لمحتواه الغني بالعناصر الغذائية، الخصائص البيولوجية واستدامة البيئة، ويستخدم الحليب النباتي في البلدان النامية كبديل غير مكلف أو لعدم كفاية حليب البقر. يعد حليب البطاطس بديل جديد، لأنه مصدر أفضل للبروتين، الفيتامينات والمعادن. يتم استهلاكه كغذاء وظيفي بسبب محتواه من مضادات الأكسدة والمواد الكيميائية النباتية. لذا هدفت هذه الدراسة إلى أثر إضافة حليب البطاطس

البيضاء وحليب البطاطا الحلوة كبديل لحليب الحيوان ومعزز حيوى فعال على الصفات النوعية و التغذوية للكيك. تم تحضير حليب بديل من البطاطس والبطاطا الحلوة، كذلك تحديد الخصائص الكيميائية، الفيزيائية والحسية. أظهرت النتائج اختلاف معنوى بين حليب البطاطس وحليب البطاطا الحلوة مقارنة بحليب الجاموسي؛ فكانت قيم البروتين (٤.٢٪ و ٩.٨٪ و ٣.٢٪) و كان محتوى الدهون والرماد (٢.٩٪ و 1.١٪) في حليب البطاطس مقارنة بحليب الجاموس (٢.١٪ و ٠.٨٪) ، كما كانت قيم الماغنيسيوم، البوتاسيوم، الزنك والحديد مرتفعة (٤١.٧ و٢١٠.٦ و١.٨ و٠.٨) مقارنة بحليب الجاموس (٣٠.٣ و١٦٥.٩ و٠.٢٤ و٠.١٤) علي التوالي، أيضاً كان لحليب البطاطا الحلوة قيم مرتفعة في التقييم الحسي كالطعم، النكهة والملمس، (٩.٤ و٩.٧ و٩.٥) مقارنة بحليب البطاطس (٧.٤ و٨.٣ و٨.٠) علي التوالي، لكن قيم اللون و التقبل العام في حليب البطاطس سجلت نتائج مرتفعة (٩.٤ و٨.٢) مقارنة بحليب البطاطا الحلوة (٧.٧ و ٧.٣) علي التوالي. كما أوضحت الخصائص الفيزيائية تقبل عام لكلاً من كيك حليب البطاطس و كيك حليب البطاطا الحلوة. **الاستنتاج:** يمكن أن يستخدم حليب البطاطس كبديل للحليب الحيواني، غذاء وظيفي و معزز حيوي فعال في الصفات النوعية و التغذوية للكيك.

الكلمات المفتتاحية: بدائل الحليب النباتي، البطاطس، حليب البطاطس، حليب البطاطا الحلوة

Introduction

Milk is an important food for the human diet due to its content of essential nutrients, research and development in nutrition science have changed consumer awareness and research of new natural components as functional foods that supply more nutrition and health **(Pimentel et al., 2015).** Functional foods contain of bioactive compounds and source of fiber which reducing the danger of chronic disease such as diabetic disease, that can be act as an antioxidant **(McCarty, 2003)**, so the vegetable-based substitutes can be used alternative to vegetarians or they are suffering from dairy-related gastrointestinal disorders, included milk protein allergy or lactose intolerance or as lifestyle or environmental considerations **(Vandeplas and Minten, 2015)**. Regarding to the world food as an energy source, potato stands is the fourth one following rice, wheat, and maize, it is a good source of protein, vitamins and minerals, addition to a high level of antioxidants and phytochemicals, so potatoes consider as functional food due to an important dietary source of bioactive ingredients **(Anitha and Manivannan, 2024)**. Potatoes are a wholesome and nutritious food due to resistant starch that plays an important role in a balanced diet. It contains 15% of dietary calories and functional ingredients like protein, starch, bioactive such as vitamins, photochemical, and fiber **(Birt et al., 2013; Shen etal., 2017).** Freshly

potatoes has water (75-80%), carbohydrates (16-20%), protein (2.5-3.5%), minerals (0.8-1.2%) such as (calcium, potassium, magnesium, iron), fats (0.1-0.2%), fiber (0.6%), vitamins (C and B such as riboflavin, thiamin, folate and B6) and a number of essential amino acids as isoleucine, leucine and tryptophan **(Storey and Anderson 2013; Bag et al., 2015; Dietary Guidelines Advisory Committee, 2015; Katherine and Beals, 2019).** The protein quality is expressed as a "biological value" based on the amino acid content and bioavailability. Egg protein is the reference protein with a biological value of 100. Potatoes have a high biological value (90) Compared with soybeans have a biological value (84) and beans (73). Potatoes contain the nine essential amino acids, so it is considered a complete protein. It contains Patatin (up to 40%), protease inhibitors (50%) and the three main proteins present in potato isolate (10%). Patatin possesses antioxidant activity and lipid acyl hydrolase activity. Potatoes have foaming and emulsifying properties, inhibitors are anti-carcinogenic, antimicrobial and high satiety properties by the hunger suppressant cholecystokinin **(Deveaux-Gobert, 2008; Kudo etal., 2009; Akilen et al. 2016).** Studies have shown that potato protein was the best plant proteins and was similar to animal proteins in essential amino acidc **(Gorissen et al., 2018).).** According to **Katherine and Beals, (2019)** reported that potatoes produce collagen needed to support cardiovascular function, maintenance of cartilage, bones, teeth and wound healing. Potatoes also provide the sources of potassium more than foods rich in potassium, such as bananas, oranges and broccoli; it also provides vitamin C and dietary fiber **(DGA, 2015; Katherine Beals, 2019).** Potato with the skin provides 48 mg of magnesium **(Freed man and Keast, 2011).** It also contain carotenoids like (lutein, zeaxanthin and violaxanthin) and phenolic acids phenolic compounds such as chlorogenic acid, anthocyanin and flavonoid such as Quercetin that it has antioxidant and anti-inflammatory properties **(Brown, 2005; Liu, 2013, McGill et al., 2013; Kawabata et al. 2015).** Milk and its derivatives is the one of food with essential nutrition; there is a need for search on alternatives for persons suffering from problems related to diet as high cholesterol, lactose intolerance or milk proteins allergy or low availability of certain minerals as iron, vitamins as folate and amino acids or adherence to a vegan (**Vandeplas and Minten, 2015; Bridges, 2018; Paul et al., 2020).** On other hand, milk is considered as a whole complete food and it is rich in nutrients and low level of fibre content **(Wandanu et al., 2022)**, it is also providing fat, proteins, carbohydrates, calcium, selenium, riboflavin, vitamin B12, pantothenic acid and vitamin B5 **(Silva et al., 2020)**. Research and development in nutrition science have changed consumer awareness of conventional food sources to functional foods that provide the health. Plant-based milk alternatives emerged, an

inexpensive, a functional food improve immune system. Using vegetables to produce a novel milk substitute such as using potatoes to produce a milk-like substitute due to their high nutritious content, bioavailability, environmental sustainability, free of soy, gluten and sugar **(Beezhold et al., 2015)**. Potato milk will an upcoming trend in plant-based milk. Potato juice is used as an additive in producing health-promoting food for patients suffering from inflammatory bowel syndrome; it has antispasmodic and antacid effect, treat hyper-acidic stomach complaints **(Baranowska et al., 2018).** Sweet potato is an alternative food option because of its health benefits and high economic potential **(Rosyidah, & Mulyatiningsih, 2021)**. It contains 15.93% carbohydrate and 2.95% total dietary fibers, 1.2% proteins, 0.63% Ashe and 0.13% lipids, addition to vitamins and minerals **(Elsabie and Asmaa, 2011)**, these nutrients particularly fiber and pectin have the prevention of cancer, cardiovascular disease, digestive disorders such as hemorrhoids, constipation and colon cancer **(nutrikidz.net, 2011)**. Studies on experiment animals revealed that sweet potato helps to stabilize blood sugar levels and lower insulin resistance, so it is a beneficial food for diabetics **(Suryia-Zakir, 2008)**, it is a lower calories and no fat. It makes to improvement heart attack and stroke, as well as its potassium content helps electrolyte balance in the body cells. The analyse of proximate composition have shown that Orange sweet potato juice is proven to be high in beta-carotene with a value of 4916.06 µg/L , and also rich in vitamins, certain amino acids and minerals, these phytochemicals act as anti-mutagenic, immune-enhancers, anticancer, and free radical scavengers **(Nurul Ainina Zulkifli et al., 2020)**. The goal of this research was to effect of addition white potato milk and sweet potato milk as an alternative to animal milk and an effective probiotic on the quality and nutritional characteristics of cake.

Material and Methods

Materials

- wheat flour (72% extraction), potato, sweet potato, sugar, salt, egg, oil, vanilla, baking powder were obtained from the local market Cairo, Egypt in El- Fayoum.

Methods

Preparation of Potato milk and sweet potato milk

There are various methods for preparing potato milk and sweet potato milk:

1-The first method: Potato or sweet potato (orange flesh) were cleaned by water, the skin was removed and then manually cut using a knife **(Shih et al., 2009)**, then then mixture in the electric blender, filtration, and then addition oil such as rape seed oil and flavored materials such as vanilla, and a few almonds may be added as flavored materials.

2-The second method: potato powder or sweet potato powder were mixed with water (1:13 w/v) and allowed to hydrate in refrigerator (4°C) for 12 hours, then it was heated in a water bathat teamperature (45–60° C) for 10 min. According to **Lize Theunissen et al., (2024)** mentioned that to make the potato milk, the potatoes are processed into a powder. The raw potatoes are washed, peeled, and sliced, then boiled until soft and strained to remove the excess water; the potatoes are then mashed and spread thinly on a baking tray. It is then dehydrated and ground into a fine powder using a high-speed blender. The potato milk is then produced by blending the potato powder and water in a high-speed blender, with added minerals, then ingredients are added include canola oil, a flavour-masking agent, fructose, salt, flavourings, and a sweetness enhancer, and the mixture is blended again and ready to be bottled.

3- **The third method:** Potato or sweet potato were peeled and either baked or boiled to become soft and fluffy. Add the boiled potatoes and cooking water to the blender, mix well, then add more fresh water and blend in the blender, then filter with a fine-weave cheesecloth, and addition vanilla, sweetener such as sugar or honey and blended to get potato milk or sweet potato milk.

Preparation of cake

Preparation of cake (potato milk and sweet potato milk)

Cake control was made using the creaming mixing technique according to **Akubor, (2004).** Wheat flour (100 g), egg (80 ml), icing sugar (100 g), salt (0.4 g), butter (60 g), milk (40 ml), baking powder (10 g), and vanilla (5 g). Initially, the margarine and sugar were creamed manually until soft and fluffy, mixer bowl with a speed setting of 1200 rpm was used to beat together the ingredients for the dough for 5 minutes. Next, combine the egg, vanilla, and batter properly with a mixer set to 2400 rpm. In potato cake and sweet potato, it follows the same previous components and replaces milk with potato milk and sweet potato milk, finally, add flour and baking powder and thoroughly combine for 5minutes. The batter was then evenly put into the cake cases a greased and baked in preheated oven at 200 °C for 35 minutes. **Chemical analysis**

Proximate Analysis of Ingredients

The experiments were conducted at the Agricultural Research Center, Giza, Egypt. Moisture, protein, fat, ash and fiber content in raw materials were determined according to the method of **A.O.A.C. (2012).** Total fat of potato milk was determined according to **James (1995)**. Total carbohydrate content was calculated by difference according to **Onivogui et al. (2014).** Minerals quantification of potato milk and sweet potato milk were carried out by atomic absorption spectrophotometer after

sample digestion with HCl according to the method of **Gupta et al. (2011).**

Determination of color characteristics

Color of potato milk was measured using spectro colorimeter (Tristimulus Color Machine) with the CIELAB color space (International Commission on Illumination). The color values were expressed as L (lightness or brightness/darkness), a (redness/greenness), and b (yellowness/ blueness). The Hue (H), Chroma (C), and browning index (BI) were calculated according to the method of **Nabil et al., (2020)**. The experiments were conducted at the National Research Center. Dokki, Egypt

Physical Properties of Cake

The weight (g) of control cake, potato milk cake and sweet potato milk cake were determined after cooling for one hour by weight measurement using the electronic digital balance, volume (Cm^3) was measured of the same products by rape seed displacement according to **A.A.C.C. (2000)**, the height was measured in the center of the cake by tape measure, then specific volume (g/cm3) of cake was calculated by dividing volume by the weights (g) of each cake samples.

Sensory evaluation

Potato milk, sweet potato milk and samples of cake were subjected to sensory evaluation the products using (20) members at the Faculty of Specific Education, Department of Home Economics, Fayoum University, Egypt randomly selected. For overall acceptability and sensory properties of taste, color, flavor, texture and overall acceptability according to **Bozdogan et al. (2019)**. Scores were based on a hedonic scale of (1 to 5), where 1 (dislike very much) and 5 (like very much) (**Larmand, 2000; Lawless, 2013).** According to **Lize Theunissen et al., (2024)** mentioned that potato milk has a faint potato flavor, an off white colour, a neutral taste and it is not predominantly sweet or savory. Potato milk characterizes doesn't separate when added to hot drinks as tea and coffee, its texture is creamy like other milk alternatives, enough foaming potential for coffee. Also, it is nutritious, low in sugar and saturated fat, and it is free from the materials caused allergens, like lactose, soy, gluten and nuts, it is available in market three versions (original, barista and unsweetened).

Statistical analysis

The analytical data were analyzed using SPSS program. Means and standard deviations were determined using descriptive statistics, comparisons between samples were determined using (AN OVA), and differences between means were considered significant at ($P \leq 0.05$).

Results and Discussion

Chemical composition of buffalo milk, potato milk and sweet potato milk

The chemical analysis of whole milk, potato milk, and sweet potato milk are shown in **Table 1**. Protein, fiber, and ash concentrations were the highest in sweet potato milk (9.8, 2.1 and 2.2), follow potato milk (4.2, 1.3 and 1.1) compared to the same measure of buffalo milk (3.2, 0.0 and 0.8) respectively. Our findings for sweet potato milk were somewhat consistent with those of **Olaleru and Abu, (2020)** studied the chemical composition of two varieties of sweet potato composite meals. Sweet potato (Orange flesh) is high in crude protein, crude fibre and ash, which were (9.80, 1.95 and 2.23) respectively. Also, **Shitophyta, (2020)** reported that sweet potato is contain largest carbohydrate source, starch (16-24%), fiber, minerals, vitamins, and bioactive compounds. Also, **Nurul Ainina Zulkifli et al., (2020)** studied that orange fleshed sweet potato juice has health benefits and can be processed into a healthy drinking juice rich in amino acids and phytochemicals which can help enhancing immunity, prevention of cancer and free radical. According **Anitha and Manivannan, (2024)** studied potato milk a possible alternative for consumers allergic to cow milk proteins to produce a milk-like substitute due to their high nutritious content, bioavailability, and environmental sustainability. Potatoes are a better source of protein, vitamins, and minerals than grains and legumes, high level of antioxidants and phytochemicals, so potato considers as functional food because of its content of bioactive ingredients. **(Camire et al., 2009)** mentioned that potatoes are important and are a staple food since they contain 15% of dietary calories and functional ingredients like starch, bioactive such as, vitamins, photochemical, and fibre, also potatoes have higher protein. According to **Levy et al., (2021)** reported that potato juice is of interest due to its protein nature; though present in small amounts, it is equivalent to animal protein, especially the substance patatin and protease inhibitors, Potato protein equivalents to egg white protein.

Table 1. Chemical composition of buffalo milk, potato milk and sweet potato milk

Nutrients	Type of milk		
	Buffalo milk	Potato milk	Sweet potato milk
Protein %	3.2 ± 0.11^{a}	4.2 ± 0.04^{b}	9.8 ± 0.01^{c}
Carbohydrates %	4.8 ± 0.53^{d}	90.8 ± 2.12^{e}	14.1 ± 0.06^{f}
Fats %	2.1 ± 0.32^{a}	2.9 ± 0.01^{a}	0.1 ± 0.001^{b}
Fiber %	0.00	1.3 ± 0.63^{e}	2.1 ± 0.05^{f}
Ash %	0.8 ± 0.11^{e}	1.1 ± 0.02^{f}	2.2 ± 0.03^{g}
Moisture %	83.8 ± 1.24^{a}	90.9 ± 1.62^{c}	85.8 ± 0.01^{a}
Energy value Kcal/100g	61.2 ± 0.41^{a}	402.6 ± 0.03^{b}	54.5 ± 3.01^{c}

*On dry weight basis * Each mean value, within the same raw, followed by the same letter is not significant different at (P< 0.05).
*Each mean value is followed by ± standard deviation.

Minerals content of potato milk and sweet potato milk

Mineral content of potato milk and sweet potato milk compared to buffalo milk showed in Table 2.The results showed that potato milk was rich in potassium (210.6) compared to potassium content in buffalo milk (165.9). Also, the results showed that potato milk rich in minerals such as (Ca= 11.2, p= 12.3, Mg=41.7, Na= 47.7, K= 210.6 and Zn= 1.8), according to **(Jang et al., 2011)** reported that potatoes deliver magnesium, potassium, fiber, and Vitamin C, raw potato juice is an excellent food remedy for rheumatism **(Jang et al., 2011)**. It had good amounts of minerals. It had the higher content of calcium (9.17±0.05 mg/100g). Phosphorus was reported (12.33 mg/100g). Magnesium content was high (56.70mg/100g). The higher sodium content was in potato milk (47.67mg/100g). These results were in agreement with **(Anitha and Manivannan, 2024)** who reported that the developed potato milk has adequate micronutrients such as (Ca, Mg, Zn, Na, Fe, P, K and Mn) to maintain stable health, making it is an alternative to dairy products. According to the study of **Strickland (2009)** stated that magnesium maintains nerve function, supports immune system, regulation blood glucose levels, synthesis of protein, energy production and regulation blood pressure. Potato juice provides as much calcium as cow's milk, and the iron content is higher than other non-dairy milk **(Levy et al., 2021)**. According to **Nurul Ainina Zulkifli et al., (2020)** studied that the orange fleshed sweet potato juice has health benefits and can be processed into a healthy drinking juice rich in vitamins, amino acids and minerals; these nutrients are consider phytochemicals which have a role in the reduction of anti-mutagenic, immune promotion, anti-cancer, and prevention of free radicals.

Table 2. Minerals content of potato milk and sweet potato milk (mg/100g)

Minerals	Type of Milk		
	Buffalo milk	Potato milk	Sweet potato milk
Ca	162.8±3.21 ^{a}	11.2±0.05^{b}	0.2±0.0001^{c}
P	111.5±2.11^{d}	12.3±0.02^{e}	___
Mg	30.3±0.03^{f}	41.7±1.15^{g}	___
Na	49.7±2.11^{a}	47.7±0.72^{a}	0.3±0.0001^{c}
K	165.9±2.51^{e}	210.6±0.33^{f}	0.1±0.0004^{g}
Cu	0.04±0.001^{d}	0.6±0.04^{e}	___
Zn	0.24±0.004^{c}	1.8±0.64^{d}	___
Mn	0.02±0.00056^{f}	0.3±0.001^{g}	___
Fe	0.14±0.001^{a}	0.8±0.01^{b}	0.4±0.0001^{c}

* The data presented as mean ±SD. of three replicates analyses In same rows, means with same letters do not differ significantly (P< 0.05).

Proximate chemical composition of cakes (control, potato milk and sweet potato milk)

Approximate chemical content of cakes (control, potato milk and sweet potato) were shown in **Table 3.**

The results were shown that cake made from potato milk recorded values 9.8, 0.3, 62.3, 0.5, 0.9 and

29.5 in protein, fat, carbohydrate, fiber, ash and moisture respectively. It recorded high values in carbohydrate and moisture, compared to control cake 56.7 and 23.1. There isn't significant different in values of protein, carbohydrate, fiber, Ash and moisture of sweet potato cake 8.9, 58.2, 0.8, 1.9 and 25.8 compared to control cake 8.2, 56.7, 0.6, 1.7 and 23.1. These results agreed with **Anitha and Manivannan, (2023)** studied nutritional evaluation of potato milk produced by ultra-sonication–A functional alternative for bovine milk, potato milk contains macro and micronutrients to maintain stable health and making it an alternative to dairy products. According to **Olatunde et al., (2019)** indicated that it can make nutritious cake from composite flour of wheat, pigeon pea and sweet potato flour.

Table 3: Proximate chemical composition of cakes (control, potato milk and sweet potato milk)

Parameters	Cake samples		
	Control	Potato milk	Sweet potato milk
Protein	8.2 ± 0.20^{a}	9.8 ± 0.03^{b}	8.9 ± 1.33^{a}
Fat	27.4 ± 1.51^{c}	0.3 ± 0.01^{e}	12.7 ± 1.15^{d}
Carbohydrate	56.7 ± 0.96^{f}	62.3 ± 0.13^{g}	58.2 ± 0.03^{f}
Fiber	0.6 ± 0.02^{h}	0.5 ± 1.61^{k}	0.8 ± 2.00^{h}
Ash	1.7 ± 0.41^{i}	0.9 ± 0.43^{k}	1.9 ± 0.51^{i}
Moisture	23.1 ± 1.23^{d}	29.5 ± 0.05^{c}	25.8 ± 2.1^{d}

Results are presented as the mean± SD of three replicates. In same rows, means with same letters do not differ significantly ($P< 0.05$).

Physical properties of cakes prepared from potato milk and sweet potato milk

Physical properties of cakes (height, weight, volume and specific volume) of produced cake were found in **table 4.** Slight differences could be observed in control cake and cake prepared of potato. The data showed that height, weight, volume and specific volume in samples of cake increased by difference the type of milk. The height recorded (6.4 and 6.9) compared to control cake (6.1), weight recorded (35.3 and 38.1) compared to control cake (34.2), volume recorded (630.9 and 728.1) compared to control cake (420.8) and specific volume recorded (17.91001 and 19.0944) compared to control cake (12.3139) respectively **(Van, Hal, 2000)**.

Table 4. Physical properties of cakes prepared from potato milk and sweet potato milk

Physical properties / Type of cake	Height (Cm)	Cake weight (g)	Cake volume (Cm^3)	Specific Gravity (g/cm3)
Cake " control"	6.1 ± 0.13^{a}	34.2 ± 0.56^{c}	٤٢٠.8 ± 0.64^{e}	12.3139 ± 0.01^{a}
Cake prepared from potato milk	6.4 ± 0.16^{a}	35.3 ± 0.18^{c}	٦٣٠.9 ± 0.71^{f}	17.91001 ± 0.05^{b}
Cake prepared from sweet potato milk	6.9 ± 0.19^{b}	38.1 ± 0.11^{d}	٧٢٨.1 ± 0.91^{g}	19.0944 ± 0.03^{b}

* Results are presented as the mean± SD of three replicates. In same colums, means with same letters do not differ significantly (P< 0.05).

Sensory evaluation of potato milk, sweet potato milk and cake samples

The sensory quality is very important for the food and beverage products, the sensory evaluation of consumer products is by experimental design and statistical analysis to human senses **(Kuenzel et al., 2011)**. According to the results in Table 5, the sensory evaluation (color, taste, flavor, mouth feel, texture and similarity) of potato milk, sweet potato, potato milk cake and sweet potato milk cake was similarity of milk, but there were significantly different ($p < 0.05$) among milk types and cake products. The potato milk had the highest values in sensory evaluation; it was (9.4, 7.4, 8.3, 8.0 and 8.2) for color, taste, flavor, texture and general acceptance respectively, compared to sweet potato milk; which was (7.7, 9.4, 9.7, 9.5 and 7.3). On the other hand, sweet potato milk was a good in taste, flavor and texture, which were (9.4, 9.7, 9.5) compared to the same measures of potato milk, which were (7.4, 8.3, 8.0), but the color and overall acceptances values of potato milk recorded the highest values (9.4, 8.2) compared to the same values of sweet potato milk (7.7, 7.3). Also sweet potato milk cake had given the highest values in sensory evaluation; which were (9.8, 9.9, 9.9, 9.9, 9.7 and 9.8) for color, taste, flavor, texture, Pores and overall acceptance respectively, compared to potato milk cake (8.3, 8.7, 9.4, 8.1, 7.3 and 8.4), in general, all cake samples were sensory acceptable. Potato proteins are considered safe food ingredients, non-allergenic, and have been incorporated in commercial food products such as Burger, due to its contain antimicrobial, antioxidant, and anti-allergic compared to proteins from other sources. Patatin exhibits gelling properties, whereas protease inhibitors are suitable for stabilization for a high-quality food, the ability of the protein to produce stable foam is important. The smoothness and froth produced are associated with bubbles, which improve the palatability and volatilization of flavor **(Levy et al., 2021)**. According to **Eman F. El-Bialy, et al., (2020)** prepared the non-dairy alternative milk healthy and tasty for lactose and casein intolerance. The results showed

that all alternatives milk samples recorded high values for sensory properties. Meanwhile, **(Baranowska et al., 2018)** mentioned that potato milk is a plant-based milk. its naturally flavor, creamy because of natural starch, potato juice is characterize their anti-inflammatory activity, it is used as an additive in producing health-promoting food for patients with inflammatory bowel syndrome, and it is used for hyper-acidic stomach complaints. According to **Hari Hariadi et al., (2023)** Studied of addition sweet potato extract on sensory evaluation and antioxidant activity in yoghurt, the results showed that the preferred yogurt with a value of taste, flavor and color by the volunteers was yogurt with 15 mg of purple sweet potato extract. Also **Enas Abdel Ati et al., (2023)** showed the sensory evaluation results of cake with 20% sweet potatoes flour is the most acceptable in overall acceptability, color and texture. According to **Ahmad Harjono et al., (2022)** they made dairy product from purple sweet potatoes, and reported that this drink is consider a healthy and refreshing drink attract the general public and increase the economy of the local community.

Table 5. Sensory evaluation of potato milk, sweet potato milk and cake samples

Sensory evaluation	Milk		Cake samples		
	Potato	Sweet potato	Control cake	Potato	Sweet potato
Color, 10	9.٤ ± 0.05^{a}	7.7 ± 0.03^{b}	10^{c}	8.3 ± 0.01^{d}	9.8 ± 0.21^{a}
Taste, 10	٧.4 ± 0.02^{e}	9.4 ± 0.04^{f}	10^{g}	8.7 ± 0.41^{h}	9.9 ± 0.01^{g}
Flavour, 10	٨.٣ ± 1.11^{a}	9.7 ± 0.51^{b}	9.9^{b}	9.4 ± 0.14^{c}	9.9 ± 0.03^{b}
Texture, 10	٨.٠ ± 0.٢3^{e}	9.5 ± 0.71^{f}	10^{g}	8.1 ± 0.54^{e}	9.9 ± 0.05^{g}
Pores	____	_____	10^{a}	7.3 ± 0.03^{b}	٩.٧ ± 1.14^{c}
Overall acceptance	٨.٢ ± 0.12^{a}	7.3 ± 0.10^{b}	9.9^{c}	8.4 ± 1.10^{a}	9.8 ± 0.04^{c}

*Values are expressed as mean ±SD * Significant at p≤0.05 using one way ANOVA test. *LSD: Least significant difference.

Conclusion

Although milk is an important food and an essential of the human diet, has long been consumed as a beverage: due to its contents of essential nutrients, which are not found in other foods, using plant- based milk substitutes is an alternative to consumers who cannot consume dairy and its derivatives, Consumers demand innovative food products due to increasing population, household incomes, changing lifestyles, and health issues like malnutrition, Plant-based milk substitutes are taking over the markets for consumers suffering from high cholesterol, milk protein allergy or lactose intolerance or as lifestyle; potato milk will stand out from other plant-based milks, which that it has homogenization, proper stabilization, and fortification; it can serve as an functional food. Future prospects may formulate potato milk to stand out from all other nondairy alternatives and ferment it with probiotic bacteria to enhance its

bio functionality, so, this work aimed to effect of addition white potato milk and sweet potato milk as an alternative to animal milk and an effective probiotic on the quality and nutritional characteristics of cake. From the above study, it was concluded that, potato milk and sweet potato milk has homogenization, proper stabilization, and fortification; it can use as a functional food due to it contains adequate macro and micronutrients to maintain stable health, making it is an alternative to dairy products. Generally, potato and sweet potato can be developed as a sustainable component for dairy products to improve and enhance human health.

Milk (potato and sweet potato) and cake samples

Sweet potat

Potato

Potato milk at home

Potato milk

Potato milk cake

Cake " control"

Sweet potato and Sweet potato milk

Sweet potato milk cake

Cake "Control"

Cake "control"

References

1- Ahmad Harjono, Ahmad Busyairi, Hairunisa Sahidu, Itsna Hasanah, Sir Atinnur Rahman, Chintya Ananditha, Nurhasanah, Nurjannah, Ari Nashiruddin Zaini, Mardiyanti, Astuti, Siti Hajar, Sulastri, Herlinda Febriani and Ni Putu Puspa Widyarni Sari, (2022). Development of processed products made from sweet potatoes into sweet potato milk (Violatte) to improve the economy of the community in Dopang Village, West Lombok Regency. Unram Journal of Community Service. Volume 3, Issue 2, 53-57.

2- Akilen R.D., Neljoomanesh N. Hunschede S. Smith C.E. Arshad M.U. Kubant R and Anderson G.H., (2016). The effects of potatoes and other carbohydrate side dishes consumed with meat on food intake, glycemia and satiety response in children. Nutr Diabetes. 6: e195.

3- Akubor, P.I., (2004). Protein contents, physical and sensory properties of Nigerian snack food (cake, Chin-chin and puff-puff) prepared from cowpea-wheat flour blends. International Journal of Food Science and Technology, 39, 419–424.

4- Anitha S and Manivannan, (2023). Nutritional evaluation of potato milk produced by ultrasonication–A functional alternative for bovine milk. Food and Humanity Volume 1, December 2023, Pages 684-688.

٥- Anitha S and Manivannan, (2024). A review on potato milk: A possible alternative for consumers allergic to cow milk proteins. Indian Journal of Natural Products and Resources Vol. 15(1), pp. 54-64.

٦-AACC, (2000). Approved Methods of the American Association of Cereal Chemists. 10th Ed. Vol. II. A.A.C.C. Methods 74-09. American Association of Cereal Chemists. St. Paul, Minn, USA.

٧- AOAC, (2012). Association of official analytical chemists. Official Methods of Analysis, 19th (ed). Maryland, USA.

8-Bag T.K, Srivastava A.K, Yadav S.K, Gurjar M.S and Diengdoh L.C., (2015). Potato (Solanum tuberosum) aeroponics for quality seed production in northeastern Himalayan region of India, Indian J Agric Sci, 85(10), 1360-1364, doi: org/10.56093/ijas.v85i10.52303.

9- Baranowska H.M, Masewicz Ł., Kowalczewski P.Ł, Lewandowicz G., Piątek M., (2018). Water properties in pâtés enriched with potato juice, Eur Food Res Technol, 244, 387-393.

10- Beezhold B., Radnitz C., Rinne A and DiMatteo J., (2015). Vegans report less stress and anxiety than omnivores, Nutr Neurosci, 18(7), 289-296.
11-Birt D.F, Boylston T., Hendrich S., Jane J.L, Hollis J., (2013). Resistant starch: Promise for improving human health, Adv Nutr, 4(6), 587-601.
12- Bischoff S.C., (2011). Gut health': A new objective in medicine? BMC Medicine 9: 24.
13- Borgi L., Rimm E.B. Willett W.C and Forman J.P., (2016). Potato intake and incidence of hypertension: Results from three prospective US cohort studies. BMJ 353: i2351.
14- Bozdogan N., Kumcuoglu S and Tavman S., (2019). Investigation of the effects of using quinoa flour on gluten-free cake batters and cake properties. J. Food Sci. and Technol., 56: 683-694.
15- Bridges M., (2018). Moo-ove over, cow's milk: the rise of plant based dairy alternatives. Practical Gastroenterology, 20- 27.
16- Brown C.R., (2005). Antioxidants in potato, Am J Potato Res, 82, 163-172.
17- Brown C.R., Culley D. Yang C.P. Durst R and Wrolstad R., (2005). Variation of anthocyanin and carotenoid contents and associated antioxidant values in potato breeding lines. Journal of the American Society for Horticultural Science 130: 174–180.
18-Brown C.R., (2008). Breeding for phytonutrient enhancement of potato. AmericanJournalofPotatoResearch85: 298–307.
19- By Lize Theunissen, Courtney Hildebrandt, Lara Havenga, Ilke Olivier, Zàn-Mari Roth, Christopher Doms and Elzaan Louw, (2024). Potato milk: The cream of the crop.
٢0- Deveaux-Gobert V, Protéines de pommes de terre: vers de nouveaux axes de valorisation?, Cah Agric, (2008), 17(4), 407-411, doi: org/10.1684/agr.2008.0214.
٢1- Elsabie Wafaa B and Asmaa H.H. Aziz, (2011). Milk permeate beverage fortified with sweet potato paste. J. Food and Dairy Sci., Mansoura Univ., Vol. 2 (8): 459 – 468.
٢2- Eman F., El-Bialy, Manal H., Abd-Elkader; Nahed S.Yousef, (2020). Non-Dairy Alternative Milk for People with Lactose and Casein Intolerance. J. of Food and Dairy Sci., Mansoura Univ., Vol 11 (12):347 – 353.
٢3- Enas M.E., Abdel Ati A.A-E., Al-Nashwy S.M., Abu Al-Maati and Eman T. Abou Sayed Ahmed, (2023). Physico chemical nutritional and sensory properties of cake based on broken rice and sweet potato composite flour Zagazig J. Agric. Res., Vol. 50 No. (6), 893-912.
٢4- Freedman M.R and Keast D.R., (2011). White potatoes, including French fries, contribute shortfall nutrients to children's and adolescents' diets. Nutrition Research 31: 270–277.
٢5- Gentile C.L., Ward E. Holst J.J. Astrup A.M. Ormsbee J. Connelly S and Arciero P.J., (2015). Resistant starch and protein intake enhances fat oxidation and increases feelings of fullness in lean and overweight/obese women. Nutrition Journal 14: 113–123.

٢6-Gorissen Stefan H.M., Julie J.R., Crombag Joan M.G., Senden W.A., Huub Waterval, Jörgen Bierau, Lex B., Verdijk, Luc J.C and van Loon, (2018). Protein content and amino acid composition of commercially available plant-based protein isolates. Amino Acids 50(12): 1685–1695.

٢7-Gupta M., Bawa A.S and Abu-Ghannam N., (2011). Effect of barley flour and freeze thaw cycles on textural nutritional and functional properties of cookies. Food Bioprod Process, 89: 520–527.

٢8- Hari Hariadi , Diang Sagita , Laila Rahmawati , Agus Triyono , Hidayat, Nur Kartika Indah Mayasti , Kiki Kurniawan , Pradeka Brilyan Purwandoko, Cahya Edi Wahyu Anggara and Raden Cecep Erwan Andriansyah, (2023). Study of addition sweet potato extract on sensory test and antioxidant activity in yoghurt. Food Sci. Technol, Campinas, 43, e88422. DOI: https://doi.org/10.1590/fst.88422.

29- Higgins J.A and Brown I.L., (2013). Resistant starch: A promising dietary agent for the prevention/treatment of inflammatory bowel disease and bowl cancer. Current Opinion in Gastroenterology 29: 190–194.

30- Higgins J.A., (2014). Resistant starch and energy balance: Impact on weight loss and weight maintenance. Critical Reviews in Food Science and Nutrition 54: 1158–1166.

31- Jang H.L., Hong J.Y., Kim N.J., Kim M.H and Shin S.R., (2011). Comparison of nutrient components and physicochemical properties of general and colored potato, Hortic Sci Technol, 29(2), 144-150.

32- Katherine A and Beals, (2019). Potatoes, Nutrition and Health. American Journal of Potato Research 96:102–110.

33- Kawabata K., Mukai R and Ishisaka A., (2015). Quercetin and related polyphenols: New insights and implications for their bioactivity and bioavailability. Food & Function 6: 1399–1417.

34- Keenan M.J., Zhou J., Hegsted M., Pelkman C., Durham H.A., Coulon D.B and Martin R. J., (2015). Role of resistant starch in improving gut health, adiposity. and insulin resistance. Adv Nutr. 6: 198–205.

35- Kudo K., Onodera S., Takeda Y., Benkeblia N and Shiomi N., (2009). Antioxidative activities of some peptides isolated from hydrolyzed potato protein extract. Journal of Functional Foods 1: 170–176.

36-Kuenze J., Zandstra E.H., El-Deredy W., Blanchette I and Thomas A., (2011). Expecting yoghurt drinks to taste sweet or pleasant increases liking. Appetite, 56 (1): 122-127.

37- Larmand E., (2000). Methods for sensory evaluation of food. Boca Raton: CRC Press.

38- Lawless H., (2013). Quantitative sensory analysis psychophysics, models and intelligent design. Chichester: Wiley Blackwell. http://dx.doi. org/10.1002/9781118684818.

39- Levy R., Okun Z., Davidovich-Pinhas M and Shpigelman A., (2021). Utilization of high-pressure homogenization of potato protein isolate for the production of dairy-free yogurt-like fermented product, Food Hydrocoll, doi: org/10.1016/j.foodhyd.2020.106442.

40- Liu R.H., (2013). Health-promoting components of fruits and vegetables in the diet. Advances in Nutrition 4: 384S–392S.
41-McCarty M.F., (2003). A low-fat, whole-food vegan diet, as well as other strategies that down-regulate IGF-I activity, may slow the human aging process, Med Hypotheses, 60(6), 784-792.
42- McGill C.R., Kurilich A.C and Davignon J., (2013). The role of potatoes and potato components in cardiometabolic health: A review. Annals of Medicine 45: 467–473.
43- Nurul Ainina Zulkifli , Nurhanisah Mohammed Salleh , Mohd Zuhair Mohd Nor, Farah Nadia Omar, Alifdalino Sulaiman and Mohd Noriznan Mokhtar, (2020). Nutritional Properties of Orange-Fleshed Sweet Potato Juice. Advances in agricultural and food research journal. 1(1): a0000104.
44- Nutrikidz. net., (2011). Sweet Potatoes, Rich in Carbohydrates, Minerals and Vitamins Posted On Tuesday, 26 Apr 2011 By Under baby food, fruit Tags: sweet potatoes.
45- Olaleru I.F. and Abu O.A., (2020). Chemical composition of two varieties of sweet potato composite meals. Conference, 8th Asan-Nias Joint Annual Meeting. Page 896-899.
46- Olatunde S.J., Ajayi O.M., Ogunlakin G.O and Ajala A.S., (2019). Nutritional and sensory properties of cake made from blends of pigeon pea, sweet potato and wheat flours. Food Research 3 (5) : 456 - 462.
47- Onivogui G.; Zhang H., Mlyuka E., Diaby M and Song Y., (2014). Chemical composition, nutritional properties and antioxidant activity of monkey apple (Anisophyllea laurina R. Br. ex Sabine). Journal of Food and Nutrition Research, 2(6): 281-287.
48- Paul A.A., Kumar S., Kumar V and Sharma R., (2020). Milk Analog: Plant based alternatives to conventional milk, production, potential and health concerns. Critical Reviews in Food Science and Nutrition, 60(18): 3005 3023.
49-Pimentel T.C., Madrona G.S., Garcia S and Prudencio S.H., (2015). Probiotic viability, physicochemical characteristics, and acceptability during refrigerated storage of clarified apple juice supplemented with Lactobacillus paracasei ssp. paracasei and oligofructose in different package types, LWT-Food Sci Technol. 63(1), 415-422.
50- Pimentel T.C., Da Costa W.K.A., Barao C.E., Rosset M and Magnani M., (2021). Vegan probiotic products: A modern tendency or the newest challenge in functional foods, Food Res Int, 140, 110033.
51- Rosyidah R and Mulyatiningsih E., (2021). Pengembangan Pie Ubi Jalar Ungu Subtitusi Tepung Mocaf Sebagai Kudapan Rendah Gluten. Jurnal Prosiding Pendidikan Teknik Pakaian, 16 (1), 1- 6.
52- Shen D., Bai H.Z., Li Y., Yu H., Zhang L and Chen, (2017). Positive effects of resistant starch supplementation on bowel function in healthy adults: Asystematic review and meta-analysis of randomized controlled trials. International Journal of Food Sciences and Nutrition 68: 149–157.

53- Shepherd S.J. and Gibson P.R., (2013). Nutritional inadequacies of the gluten free diet in both recently diagnosed and long-term patients with coeliac disease. Journal of Human Nutrition and Dietetics 26: 349–358.
54-Shih M.C., Kuo C.C. and Chiang W., (2009). Effects of drying and extrusion on colour, chemical composition, antioxidant activities and mitogenic response of spleen lymphocytes of sweet potatoes. Food Chem., 117: 114-121.
55-Shitophyta L.M., Ardiansyah D.S.B., and Nendanov M.R., (2020). Pemanfaatan Ubi jalar (Ipomoea Babatas L.) menjadi sirup glukosa dengan hidrolisis asam. Jurnal Penelitian Sains. 22 (1), 45-49.
56- Silva A.R, Silva M.M, and Ribeiro B.D., (2020). Health issues and technological aspects of plant-based alternative milk, Food Res Int, 2020, 131, 108972, doi: org/10.1016/j.foodres.2019. 108972.
57- Storey M.L., and Anderson P.A., (2013).Contributions of white vegetables 630tonutrient intake: NHANES2009- 2010. Advances in Nutrition 4: 335S–344S.
58-Strickland E., (2009). Eating for Autism: The 10-step Nutrition Plan to Help Treat Your Child's Autism, Asperger's, Or ADHD. Da Capo Lifelong Books.
59- Surayia-Zakir, Mohammad-Sarwar, Allen-J, Butt M.S, Mehr-un-Nisa, Umair Arshad, Islam-Ud-Din and Asif-Javaid. (2008). Impact of sweet potato cultivars on blood glucose level in diabetic and healthy participants. International J. of Agriculture and Biology, 10 (3):316-320.
60-Van Hal M., (2000). Quality of sweet potato flour during processing and storage. Food Rev. Inter. 16: 1-37.
61-Vandeplas A and Minten B., (2015). Food quality in domestic markets of developing economies: A comparative study of two countries, Agric Econ, 46(5), 617-628.
62- Vinson J.A., Demkosky C.A., Navarre D.A., and Smyda M.A., (2012). High-antioxidant potatoes: Acute in vivo antioxidant source and hypotensive agent in humans after supplementation to hypertensive sub jects. Journal of Agricultural and Food Chemistry 60: 6749–6754.
63- Wandanu F., Hatta W and Nahariah N., (2022). Quality of ready to drink cow's milk purple sweet potato (Ipomea batatas L.) juice with CMC (carboxymethyl cellulose) stabilizer during cold storage. AIP Conf. Proc. Volume 2628, Issue 1, 050006.
64- Zhang L., Li H.T. Shen L. Fang Q.C. Qian L.L and Jia W.P., (2015). Effect of dietary resistant starch on prevention and treatment of obesity-related disease and its possible mechanisms. Biomed Environ. 28: 291–297.