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Effect of Replacing Wheat Flour with Pearl Millet Flour on Chemical and Sensory Properties of Bound Cake

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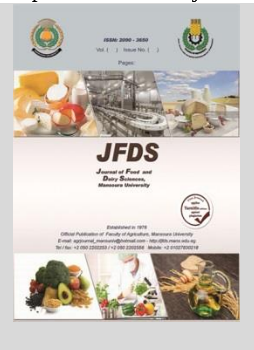

ABSTRACT

The objective of this work study the effect of replacing wheat flour 72% extraction with Pear millet flour in different ratios (100:0,40:60,60:40,80:20 and 0:100) On the chemical and sensory properties of pearl millet bound cake. The obtained results indicated that nutritional value of the bound cakes increased in terms of their protein, fiber, and mineral content. In addition, the amount of the essential and nonessential amino acids content in sample 100% millet flour in comparing with sample (A) 100% wheat flour. So, the study recommended that, the availability using of pearl millet flour at different levels into wheat bound cake formula improved their nutritional quality and sensory evaluation of cake bound produced.

Keywords: Pearl millet; Wheat flour; bound cake.

INTRODUCTION

Billions of individuals across the globe are experiencing malnutrition and confronting the issue of food insecurity. The United Nations has set a global objective to eliminate hunger by 2030; however, we are currently a long way off from reaching that target. Over the past decade, climate change, population expansion, and economic downturns have posed significant challenges to food security. Many countries are grappling with the dual issues of undernutrition and overnutrition. In order to achieve food and nutrition security, it is imperative to undertake a comprehensive transformation of the food system. (FAO 2023). One strategy to make progress towards our objective is to ensure universal access to affordable and nutritious food. Nutricereal millets have emerged as a promising solution in addressing the challenges of hunger and malnutrition. These millets possess substantial quantities of vital macronutrients, micronutrients, carbohydrates, and protein. Nutricereals offer a rich source of essential macronutrients, micronutrients, carbohydrates, protein, dietary fiber, lipids, and phytochemicals. It is worth noting that the nutritional composition and digestibility of millets can be significantly influenced by different processing methods.(Nanje Gowda *et al*., 2022) .Pearl millet holds significant importance as a cereal crop due to its nutritional richness and its ability to thrive in harsh climatic conditions. Sudden shifts in climate and other natural calamities can lead to food security issues, causing a rise in food prices and a decrease in food availability (Monika *et al.*, 2020). In the semi-arid tropics, pearl millet serves as a vital source of nutrition for millions of peoples.

Millets are an important grain worldwide are the least utilization in compared with other grains. Millet grains possess exceptional qualities as both food and feed, primarily due to their high mineral content and the presence of health-beneficial phenolic compounds. The selection of millet varieties plays a crucial role when considering their application as food or feed, as different types of millets, such as finger millet and pearl millet, exhibit a diverse range of nutrients and phenolic compounds. (Hassan *et al*., 2021).

Millets demonstrate significantly superior nutritional attributes. Serve as an excellent source of energy, carbohydrates, crude fibers, soluble and insoluble dietary fibers, as well as soluble and insoluble fats, proteins (ranging from 8% to 19%), ash, dietary fibers (approximately 1.2 g per 100 g), antioxidants, and fats (between 3% and 8%) with improved fat digestibility. (Uppal *et al.*, 2015). Furthermore, millets are a notable source of essential minerals such as potassium, phosphorus, magnesium, iron, zinc, copper, and manganese, with concentrations reaching 2.3 mg per 100 g. Also contain important vitamins like thiamine, riboflavin, and niacin (Weckwerth *et al.*, 2020). Pearl millet (Pennisetum glaucum L. R. Br.), a globally significant cereal crop, faces a significant challenge to its productivity due to the impact of downy mildew caused by Sclerospora graminicola (Sacc.) (Lavanya *et al*., 2022).

Baked goods hold significant importance in human nutrition both locally and globally. Due to the gap between wheat production and demand, governments often resort to importing wheat from various countries. In the semiarid tropical regions of Africa and Asia, millets are commonly cultivated (El Tanahy *et al.*, 2021). Bound cakes, known for their appealing features and association with festive occasions and joyful holidays, are the most popular bakery product (Hafez et al., 2012; Zhang et al., 2012). This is crucial because consumers and authorities highly value the nutritional content of food. Nutritional analysis is conducted to determine the proportions of carbohydrates, fats, ash, proteins, and moisture

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in snacks like bound cakes and cookies (Kwaw and Sackey, 2013). Rajiv et al. (2011) investigated the impact of substituting wheat flour with finger millet flour at varying percentages (0%, 20%, 40%, 60%, 80%, and 100%) in bound cake production. Finger millet flour not only enhances the nutritional value of the bound cake but also adds value to the finger millet itself. The aim of this study is to raise the chemical value and sensory evaluation of bound cake product by replacing wheat flour with pearl millet flour.

MATERIALS AND METHODS

Raw Materials:

Pearl millet *(Pennisetum americanum)* was bought from a local market, El Mansoura, Dakahlia Governorate, Egypt.

Wheat flour 72% extraction (*Titricum Aestivum L.*) was purchased from a local market in El Mansoura, Dakahlia Governorate, Egypt.

Baking Ingredients Milk, salt, sugar, whole eggs, butter, vegetable oil, vanilla 6 Xtract and baking powder were obtained from Fathallah market in El Mansoura, Dakahlia Governorate, Egypt

Methods

A- Technical Methods

To prepare the bound cake, a blend of wheat flour and pearl millet flour, along with sugar, butter, vegetable oil, fresh whole eggs, baking powder, milk, and vanilla, was used in bound cake preparty. were used manually mix the ingredients well by whisking. The resulting dough was transferred into a greased pan and baked in an electric oven (MAC.PAN, Italy) at temperature of 200°C for 25 minutes. after baking the bound cake was left to cool at room temperature. The methods employed in bound cake preparation in accordance with AACC (2002) and Sharoba *et al*. (2013)

B-Chemical Methods

Determination of gross chemical composition:

The AOAC (Association of Official Agricultural Chemists) guidelines were followed to determine moisture, protein, ash, crude fiber, ether extract, starch, and reducing and non-reducing sugars (2007). Differential analysis was employed to calculate the total carbohydrate content. The energy value of the sample was determined using the following formula: (% Protein 4) + (% Carbohydrate 4) + (% Fat 9).

Determination of Minerals:

Mg, Ca, Na and K were determined using the Ienway Flamephotometer model Corning 400 to estimate flame photometrically. (Peterburgski, 1968).

Fe, Mn, Zn and Cu were determined using Atomic Absorption spectrophotometer (A Perkinelmer, Model 2380.usa) were calculated utilizing Chapman and Pratt (1961**)**.

Determination of Amino acids:

Amino acids content was determined according to the method of Sadasivam and Manickam **(1992)** by using Amino Acid Analyzer (Beckman Amino Acid Analyzer, Model 119 CL). Tyrptophan content of samples was determined calorimetrically in the alkalin hydrolyzate following the method of Miller (1967).

Determination of proactive compound and antioxidant activity

Determination of total phenols

The powdered plant material (2 g) was extracted with methanol, at room temperature overnight. The methanol extract of were combined and concentrated under reduced pressure on a rotary evaporator. Total phenolic content of each plants extract was determined with the Folin–Ciocalteu's reagent (FCR) according to the published method. Each sample (0.5 ml) was mixed with 2.5 ml FCR (diluted 1:10, v/v) followed by 2 ml of Na2CO3 (7.5 %, v/v) solution. The absorbance was then measured at 765 nm after incubation at 30°C for 90 minutes. Results were expressed as Gallic acid equivalent (mg Gallic acid /g dried extract). (Slinkard and Singleton, 1977)

Determination of flavonoids

The total flavonoids content of plants extracts was determined by a colorimetric method as described in the literature. Each sample (0.5 ml) was mixed with 2 ml of distilled water and subsequently with 0.15 ml of a NaNO2 solution (15%). After 6 minutes, 0.15 ml of aluminum chloride (AlCl3) solution (10 %) was added and allowed to stand for 6 minutes, then 2 ml of NaOH solution (4 %) was added to the mixture. Immediately, water was added to bring the final volume to 5 ml and the mixture was thoroughly mixed and allowed to stand for another 15 minutes. Absorbance of the mixture was then determined at 510 nm versus prepared water blank. (Zhishen *et al*., 1999)

Determination of DPPH free radical scavenging activity: -

DPPH free radical scavenging activity Determination of DPPH of cruciferous vegetable extracts was based on previous method of Nuengchamnong and Ingkaninan (2010). 100 µl of each extract was mixed with 2.9 ml of 0.05 mM methanolic DPPH solution. The mixture was vortexed for 10 seconds and allowed to stand for 30 min at a dark place. Then, absorbance was measured using a spectrophotometer (UV-Vis spectrophotometer, Thermo Scientific, Genesys 20) at 517 nm. The experiment was carried out in triplicates. The percentage of the DPPH free radical was calculated using the following equation:

DPPH scavenging effect (%) = A0 – A1 / A0 x 100

Where A0 represents absorbance of DPPH and A1 represents absorbance of DPPH and sample.

Determination of ß-carotene

β-carotene was determined according to the method of Nagata and Yamashita (1992) 1g of fresh weight of sample was separately homogenized with 10 mL of an acetone–hexane mixture (2:3) for 2 minutes to uniform mass. Samples were maintained in an ice-water bath to prevent over-heating of the samples. Homogenates were centrifuged at 5000 rpm for 10 minutes at 20 °C. The absorbance spectrum of each supernatant was measured, and the absorption maxima were read at 453, 505, 645 and 663 nm (UV/VIS spectrophotometer Cary 50 Scan). *β*-carotene content was calculated from the following equation:

$$\beta\text{-carotene (mg/100ml)} = 0.216\,A_{663} - 1.22\,A_{645} - 0.304\,A_{505} + 0.452\,A_{453}$$

Sensory Evaluation of cake bound:

The bound cakes were put through a sensory evaluation utilizing the AACC (2002). A total of 50 semi-trained panelists took part in the evaluation. Overall appearance, drumming, crust and crumb colors, taste, mouthfeel, cohesion, height, textures, aroma, and overall acceptability were among the qualities evaluated. In discrete cubicles with adequate lighting, the coded samples were served in clean plastic plates at room temperature. The panelists were given a random sample presentation. Panelists were asked to sample items and rate them based on a rating made on a scale of 1 to 10, where 1 was the lowest rating and 10 was the highest rating.

Statistical analysis:

The collected data were presented as means with standard deviations (means S.D.), statistical analysis was performed using one-way analysis of variance (ANOVA), and the means between groups were compared using the least significant difference (LSD) was produced with the use of the Statistical Package for the Social Science (SPSS V.24) computer program. (Barton and Peat 2014).

RESULTS AND DISSCUSION

Chemical composition of different prepared cake bound samples by replacement wheat of flour with pearl millet flour.

Chemical composition is great importance in judging the quality of the bound cake sample. The moisture, ash, protein, fat, fiber, carbohydrate, and energy availability were measured. Pearl millet flour was substituted for wheat flour as mentioned in table 1. Data in Table (2) demonstrate a highest value of Moisture bound cake sample (A) (100% wheat flour) with (25.86) while least valuable in cake sample (E) (100%Pearl Millet flour) this may due to an intermolecular network, water entrapment, and a decrease in free water content, all of which are linked to a drop in food moisture content (Zhang et al., 2016) Moisture is required for bound cake to maintain its quality, and excessive moisture has a negative impact on bread storage stability. However, bound cake sample (E) with (100% Pearl Millet flour) have significantly higher than the other samples in ash (1.82), fat at (19.41), protein at (13.77), fiber at (2.02), carbohydrate (48.70) and energy (432.65). While we find bound cake sample (A) (100% wheat flour) demonstrated that lowest value of ash (1.٠٣), fat (١٥.86), protein (10.37), fiber (0.47), carbohydrate (46.87) and energy (372.78) compare with rest of Cake bound Samples. The findings published by Rajive *et al.* (2011) and El Tanahy *et al* (2021). These results are nearly in agreement with those reported by Florence Suma (2012). All the results indicated that the pearl millet flour which is a good source of protein and fat increases the nutritive value of bound cake. The composite bound cake may have had a higher protein level due to the usage of pearl Millet flour, which enhanced the protein content of the bound cake (Ijah *et al*., 2014). Comparable findings for wheat-yam flour composite bread were reported by Amandikwa et al. (2015)**,** and similar findings for wheat-sweet potato flour composite bread by Mitiku *et al*. (2018)**.** Again**,** Adegunwa *et al.* (2014) prepared samples of products using wheat and millet flour blends. They revealed that among millet-wheat composite chin-chin prepared, the 100% millet chin-chin had the highest protein content. According to well-established studies, dietary fiber is now widely recognised to play a significant role in the prevention of several diseases, including cardiovascular disease, constipation, irritable colon, cancer, and diabetes (Slavin 2005; Elleuch *et al.* 2011). As a result, these rock-bound cakes that are enriched with wheat and pearl millet flour blends might help to prevent such situations. Also, according to Anderson, Baird, and Richard (2009**),** fiber helps to lower blood cholesterol levels and slows down the process of absorbing glucose, helping to maintain blood glucose levels under control.

Table 1. Different formula of wheat flour (72% ext.) and pearl millet flour used in cake bound samples preparation.

Formula	Wheat flour (72% ext.) (gm)	Pearl Millet flour(gm)
(A)	100	-
(B)	60	40
(C)	40	60
(D)	20	80
(E)	-	100

Table 2. Chemical composition of different prepared cake bound samples by the replacement of wheat flour with pearl millet flour.

bound cake Sample	Moisture g/100g	Ash g/100g	Fat g/100g	Protein g/100g	Fiber g/100g	Carbohydratesg/100g	Energy (K Cal)
(A)	$25.86^{a}\pm0.11$	$1.03^{e}\pm0.05$	$15.86^{e}\pm0.08$	$10.37^{e}\pm0.07$	$0.47^{e}\pm0.04$	$46.87^{c}\pm0.21$	$372.78^{e}\pm3.96$
(B)	$24.11^{b}\pm0.09$	$1.12^{d}\pm0.04$	$16.74^{d}\pm0.04$	$11.16^{d}\pm0.06$	$0.64^{d}\pm0.03$	$46.85^{c}\pm0.24$	$385.26^{d}\pm4.05$
(C)	$21.35^{c}\pm0.10$	$1.20^{c}\pm0.05$	$17.20^{c}\pm0.05$	$11.73^{c}\pm0.02$	$0.81^{c}\pm0.04$	$48.50^{b}\pm0.08$a	$398.84^{c}\pm3.76$
(D)	$18.75^{d}\pm0.10$	$1.47^{b}\pm0.04$	$18.43^{b}\pm0.03$	$12.95^{b}\pm0.10$	$1.26^{b}\pm0.03$	$48.38^{b}\pm0.13$	$416.23^{b}\pm3.84$
(E)	$17.28^{e}\pm0.4$	$1.82^{a}\pm0.07$	$19.41^{a}\pm0.04$	$13.77^{a}\pm0.05$	$2.02^{a}\pm0.04$	$48.70^{a}\pm0.04$	$432.65^{a}\pm2.34$

The mean values in the same column with the same superscript do not differ substantially P> 0.05 (a,b,c,d,c,..). Values are means standard deviation of independent assessments.

Sensory evaluation of different prepared cake bound samples formulae by replacement of wheat flour with pearl millet flour.

Table 3 shows the sensory evaluation results of bound cakes using wheat/millet flour mixtures. The sensory evaluation revealed a significant difference (p<0.05) between the cake samples in overall appearance, drumming, crust and crumb colors, taste, mouthfeel, cohesion, height, textures, aroma, and overall acceptability (Table 3) as the amount of millet flour in the bound cakes increased. The sensory evaluation of the current investigation revealed a pattern that differed from that described by Sukhcharn *et al*., **(**2008). The distinctive baking quality of millet flour (Okoye, Nkwocha and Ogbonnaya, 2008; Adeyeye and Akingbala, 2015) and the varying rates of preference and acceptable values of panelists may explain the different directions of score patterns. bound cake sample B (60% wheat flour +40%pearl millet) recorded (8.21) was score for the highest appearance, crust color with (8.65**)**, while taste (8.90), odor (9.01) and overall acceptability (80.98) amount the others Cake bound Samples. While being bound cake sample A (100% wheat flour) have the highest value for drumming (8.98), Crumb color (8.54), mouth feel (9.32), Cohesion (9.07), Height at (9.67) and Texture (9.46) score in compere with the others. The bound cakes' color shifted from light brown to dark brown, and the mean scores began to decline. this may be due to Millard reaction between reduced sugar and protein (Dhingra and Jood, 2000). These findings are consistent with those by El Tanahy, *et al.* (2021).

Table 3. Sensory evaluation of different prepared cake bound samples by the replacement of wheat flour with pearl millet flour.

cake bound sample properties	(A)	(B)	(C)	(D)	(E)
Appearance	7.24±0.34^{c}	8.21±0.12^{a}	8.01±0.21^{b}	7.23±0.12^{c}	6.54±0.19^{d}
Drumming	8.98±0.45^{a}	7.51±0.20^{b}	6.88±0.39^{c}	6.12±0.31^{d}	5.62±0.21^{d}
Crust color	8.65±0.54^{ab}	8.96±0.31^{a}	7.45±0.16^{b}	7.02±0.24^{c}	5.86±0.23^{d}
Crumb color	8.54±0.21^{a}	8.02±0.17^{b}	7.01±0.41^{c}	6.56±0.10^{d}	4.98±0.17^{e}
Taste	8.65±0.18^{b}	8.90±0.21^{a}	8.56±0.07^{b}	7.54±0.25^{c}	7.32±0.06^{c}
Thawing in the mouth	9.32±0.26^{a}	8.76±0.13^{b}	7.78±0.34^{c}	6.01±0.17^{d}	5.17±0.31^{e}
Cohesion	9.07±0.31^{a}	8.21±0.18^{b}	7.54±0.13^{c}	5.78±0.31^{d}	4.43±0.20^{e}
Height	9.67±0.24^{a}	8.56±0.31^{b}	7.96±0.23^{c}	7.53±0.31^{cd}	7.07±0.08^{d}
Texture	9.46±0.19^{a}	8.76±0.43^{b}	7.98±0.09^{c}	7.01±0.20^{d}	6.37±0.15^{e}
Odor	8.76±0.52 ^{ab}	9.01±0.18^{a}	8.33±0.18^{b}	7.98±0.12^{c}	7.28±0.21^{d}
Overall acceptability %	80.71±0.22^{a}	80.98±0.34^{a}	70.12±0.09^{b}	60.49±0.09^{c}	60.01±0.19^{d}

The mean values in the same row with the same superscript do not differ substantially P> 0.05 (a,b,c,d,…) Values are means standard deviation of independent assessments.

Bioactive compounds content and of different prepared cake bound samples by the replacement wheat of flour with pearl millet flour

The antioxidant activities of phenolic compounds and flavonoids in biological systems have already been established based on their abilities to act as scavengers of singlet oxygen and free radicals**.** Polyphenols are the biggest group of phytochemicals that have been found in plant-based foods and have been linked to several health benefits. Flavonoids are antioxidants and free radical scavengers which prevent oxidative cell damage and have strong anticancer activity**.** (Okwu 2004) Phenolic compounds have health benefits as they improve human health against diabetes, cardiovascular diseases, and associated diseases because of their high antioxidant properties**.** (Nicoletti et *al* 2013). The result from antioxidant activity of (Table 4) showed increase in phenol, flavonoid, total antioxidant activity and ß-carotien values of the bound cake E sample (100% Pearl Millet flour) at 3.04, 1.85, 31.40 and 1.42 while showed decrease in phenol, flavonoid, total antioxidant activity and ß-carotien values of the sample bound cake A (100% wheat flour) at 1.62, 0.75, 24.51 and 0.78 respectively in compared with the rest of the prepared Cake bound Samples

Table 4. Bioactive compound content of different prepared cake bound samples by the replacement wheat of flour with pearl millet flour.

	Bioactive compounds			
cake bound samples	Total Phenol mg/g gallic acid	Total Flavonoid mg/g quercetin	Antioxidant activity (DPPH%)	ß-carotin mg/100g
(A)	1.62±0.05 ^{e}	0.75±0.04 ^{e}	24.51±0.82 ^{e}	0.78±0.03 e
(B)	1.36±0.08 ^{d}	0.84±0.05 ^{d}	26.35±0.74 ^{d}	0.86±0.02 d
(C)	1.57±0.08 ^{c}	1.03±0.02 ^{c}	27.81±0.07 ^{c}	0.98±0.03 c
(D)	2.12±0.07 ^{b}	1.25±0.03 ^{b}	29.3±0.78 ^{b}	1.14±0.03b
(E)	3.04±0.09 ^{a}	1.85±0.03 ^{a}	31.40±1.13 ^{a}	1.42±0.05 a

Mean values with the same superscript within the same column are not significantly different P≥0.05 (a,b,c,d,…) Values are means ± standard deviation of duplicate determinations

Mineral content of different prepared cake bound samples by replacement of wheat flour with pearl millet flour

Data in Table (5) showed the mineral contents of Cake bound Samples (mg /100 g). From data, it can be observed that bound cake sample E (100% Pearl Millet flour) was higher in Na, K, Ca, Mg, Fe and Zn values being 341.27, 226.37, 203.45, 82.05, 2.33 and 1.62 (mg / 100 g), respectively. Followed by bound cake sample D (80% Pearl Millet flour+20% Wheat flour), C (60% Pearl Millet flour+40% Wheat flour), B (40% Pearl Millet flour+60% Wheat flour) and A (100% wheat flour) respectively lower values. These results are in agreement with those obtained by Mehra and Singh (2017) and Hassan *et al* 2020 who indicated that the pearl millet had high content of minerals and vitamins. Nada et al 2016 noticed that Fe, Ca, Zn contents ware markedly higher in millet and germinated millet than rice. The germination of millet improved the mineral content and its availability (Grewal and Jood 2006).

Table 5. Mineral content of different prepared cake bound samples by the replacement of wheat flour with pearl millet flour.

	Minerals (mg/100g)					
cake bound Sample	Na	K	Ca	Mg	Fe	Zn
(A)	261.38^{e}±1.25	121.36^{e}±1.13	131.23^{e}±0.72	81.23^{c}±0.33	1.26^{e}±0.04	0.47^{e}±0.03
(B)	278.34^{d}±1.72	143.41^{d}±1.08	146.57^{d}±0.95	81.29^{bc}±0.32	1.32^{d}±0.04	0.55^{d}±0.03
(C)	294.27^{c}±2.20	166.31^{c}±1.15	158.57^{c}±0.91	81.36^{bc}±0.30	1.52^{c}±0.03	0.72^{c}±0.03
(D)	326.33^{b}±2.20	193.53^{b}±1.12	176.63^{b}±1.25	81.74^{b}±0.11	1.81^{b}±0.04	0.97^{b}±0.03
(E)	341.27^{a}±1.27	226.37^{a}±1.79	203.45^{a}±1.19	82.05^{a}±0.17	2.33^{a}±0.04	1.62^{a}±0.03

The same superscript mean values within the same column do not differ substantially P >0.05 (a,b,c,d,…) Values represent means standard deviation of independent measurements.

Essential amino acids of different prepared cake bound samples by the replacement of wheat flour with pearl millet flour

Results from essential amino acids of (Table 6) showed highest value of phenylalanine, isoleucine, leucine, lysine, methionine, threonine, valine and total essential amino acids for bound cake sample E (100% Pearl Millet flour) while found less value variables for bound cake sample A (100% wheat flour) Whoever appeared highest value of Histidine, Cysteine and Tyrosine for sample A (100% wheat flour) and less value these variables for E (100% Pearl Millet flour) compared to the rest of the Cake bound Samples. Nour *et al* 2015 found the supplementation of pearl millet with fenugreek defatted seeds flour (FDSF) increased the amino acids contents. This considered nutritionally desirable because it increase lysine content which cause improvement in the nutritional value of pearl millet. The amino acids content and score were fluctuated during processing of the flour and supplements. Millets generally contain significant amounts of essential amino acids particularly the Sulphur containing amino acids (methionine and cysteine); they are also higher in fat content than maize, rice, and sorghum (Obilana and Manyasa, 2002). pearl millet was found to contain an appropriate proportion of lysine (1822 and 1682 µg/100g), that is an essential amino acid involved in protein genesis, cross linking of collagen peptides and carnitine production. Thus the consumption of these cereals could prove effective in treatment of diseases including anemia, impaired fatty acid metabolism and defective connective tissue (Mohiuddin e*t al* 2023)

Table 6. Essential amino acids content of cake bound samples by the replacement of wheat flour with pearl millet flour.

		Cake bound Samples				
Essential amino acids		**(A)**	**(B)**	**(C)**	**(D)**	**(E)**
Phenylalanine	(gm/100g protein)	4.40^{e}±0.02	4.48^{d}±0.02	4.53^{c}±0.02	4.68^{b}±0.05	4.80^{a}±0.04
Histidine		2.85^{a}±0.03	2.71^{b}±0.04	2.59^{c}±0.04	2.45^{d}±0.02	2.01^{e}±0.04
Isoleucine		3.73^{e}±0.02	3.91^{d}±0.04	4.11^{c}±0.03	4.25^{b}±0.03	4.36^{a}±0.02
Leucine		7.71^{e}±0.03	7.84^{d}±0.04	7.96^{c}±0.05	8.11^{b}±0.02	8.33^{a}±0.03
Lysine		3.03^{e}±0.02	3.12^{d}±0.03	3.31^{c}±0.03	3.47^{b}±0.03	3.66^{a}±0.05
Cysteine		1.79^{a}±0.03	1.61^{b}±0.03	1.48^{c}±0.04	1.25^{d}±0.03	1.05^{e}±0.03
Methionine		1.95^{e}±0.03	2.06^{d}±0.02	2.18^{c}±0.03	2.24^{b}±0.03	2.37^{a}±0.04
Threonine		4.94^{e}±0.03	5.17^{d}±0.04	5.38^{c}±0.04	5.47^{b}±0.03	5.68^{a}±0.03
Valine		5.68^{e}±0.03	5.72^{d}±0.02	5.88^{c}±0.03	5.97^{b}±0.03	6.11^{a}±0.03
Tyrosine		3.47^{a}±0.05	3.32^{b}±0.04	3.21^{c}±0.04	3.05^{d}±0.03	2.88^{e}±0.03
Total essential amino acids		39.59^{e}±0.03	39.96^{d}±0.13	40.67^{c}±0.10	40.96^{b}±0.05	41.29^{a}±0.05

Mean values with the same superscript within the same column are not significantly differentP≥0.05 (a,b,c,d,…). Values are means ± standard deviation of duplicate determinations.

Non-essential amino acids of cake bound samples by the replacement wheat of flour with pearl millet flour.

The result from non-essential amino acids of (Table 7) showed highest value of cake in aspartic acid, glutamic acid, alanine, glycine, serine, arginine, total non-essential amino acids and total amino acids for bound cake sample E (100% Pearl Millet flour) while found less value these variables for bound cake sample A (100% wheat flour) .Whoever appeared highest value of proline for sample A (100% wheat flour) and less value these variables for E (100% Pearl Millet flour) compared to the rest of the Cake bound Samples. Hirayama *et al* 2016 found phenylalanine, tryptophan and tyrosine are produced at a large scale for their multiple applications in food industry. The non-essential amino acid tyrosine is synthesized from an essential amino acid phenylalanine by using an enzyme phenylalanine hydroxylase. The deficiency of phenylalanine hydroxylase causes a buildup of phenylalanine in the body and creates a disorder phenylketonuria (Tzin V and Galili G 2010) Phenylalanine is also used as a nutritional supplement for its analgesic and antidepressant effects. Total amino acid was higher in oats, pearl millet and sorghum, while as finger millet was observed to have higher content of basic amino acids. Pearl millet and sorghum was found to have higher content of conditionally essential amino acids arginine, cysteine and proline, and tyrosine. Thus these millets might be useful for supplementation of infant foods and patients with suffering from severe catabolic problems. With respect to the concentration of aromatic amino acids, oats were found to contain the highest percentage and the lowest content was shown by finger millet (Mohiuddin e*t al* 2023)

Table 7. Non-Essential amino acids content of cake bound samples by the replacement of wheat flour with pearl millet flour.

		Cake bound samples				
Cake bound Samples		**(A)**	**(B)**	**(C)**	**(D)**	**(E)**
Aspartic acid	(gm/100g protein)	4.75^{e}±0.04	4.83^{d}±0.05	4.96^{c}±0.05	5.12^{b}±0.04	5.24^{a}±0.03
Glutamic acid		23.10^{e}±0.06	23.28^{d}±0.03	23.75^{c}±0.04	24.22^{b}±0.04	24.43^{a}±0.03
Alanine		3.26^{e}±0.02	3.34^{d}±0.04	3.67^{c}±0.05	3.78^{b}±0.04	3.88^{a}±0.04
Glycine		3.68^{d}±0.05	3.76^{d}±0.03	3.88^{c}±0.04	4.01^{b}±0.05	4.23^{a}±0.03
Proline		11.97^{a}±0.04	11.81^{b}±0.03	11.63^{c}±0.03	11.15^{d}±0.04	10.98^{e}±0.04
Serine		3.66^{e}±0.04	3.74^{d}±0.03	3.90^{c}±0.05	4.12^{b}±0.04	4.29^{a}±0.04
Arginine		4.31^{e}±0.05	4.35^{d}±0.04	4.51^{c}±0.03	4.65^{b}±0.04	4.81^{a}±0.04
Total non-essential amino acids		54.73^{e}±0.16	55.13^{d}±0.03	56.30^{c}±0.13	57.05^{b}±0.21	57.86^{a}±0.12
Total amino acid		94.33^{e}±0.13	95.09^{d}±0.16	96.98^{c}±0.23	98.01^{b}±0.26	99.15^{a}±0.17

Mean values with the same superscript within the same column are not significantly different P≥0.05 (a,b,c,d,…) Values are means ± standard deviation of duplicate determinations

CONCLUSION

Pearl millet, a nutritious staple food, offers numerous health benefits. As people become more conscious about their well-being, pearl millet emerges as an alternative option for a nourishing diet. A recent investigation suggests that enriched millet flour could be used as a substitute for refined wheat flour in bound cakes. However, its high nutritional value and health advantages, the use of pearl millet is limited due to its elevated of lipid content, which negatively affects the shelf life and acceptability of pearl millet products. Various methods for processing pearl millet have been described, but further in-depth research is necessary to fully evaluate the potential and availability of this "nutricereal" in improving the quality of pearl millet products. Innovative techniques, including non-thermal approaches, are required to develop enhanced processing protocols that can extend the shelf life and preserve essential nutrients in pearl millet products. This study demonstrates that millet holds a great potential for use in bound cake formulations, aiming to enhance its nutritional qualities, chemical and sensory characteristics.

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تأثير استبدال دقيق القمح بدقيق الدخن اللؤلؤي على الخصائص الكيميائية والحسية للكعك

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الملخص

يهدف هذا البحث الى دراسة تأثير استبدال دقيق القمح (٧٢%) بدقيق الدخن اللؤلؤي بنسب مختلفة (٢٠:٨٠،٤٠:٦٠،٦٠:٤٠،٠:١٠٠ و ١٠٠:٠) على الخصائص الكيميائية والحسية لكعكه الدخن اللؤلؤي. وقد أظهرت النتائج المتحصل عليها إلى زيادة القيمة الغذائية للكعك المصنع من حيث محتواه من البروتين والألياف والمعادن. بالإضافة إلى تحسن في الأحماض الأمينية الأساسية وغير الأساسية للعينة المصنعة بدقيق الدخن للعينة ١٠٠% (E) وذلك بمقارنتها مع عينة الكعك (A)دقيق القمح ١٠٠%. لذلك أوصت الدراسة بإمكانية استبدال دقيق الدخن اللؤلؤي بمستويات مختلفة في تركيبة القمح لتحسين صفات الجودة الغذائية والحسية للكعك المصنع.