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Utilization Of Millet (pennisetum glaucum) flour To produce gluten-free toast bread.

Nahla S Zidan[1,2]

1 Department of Nutrition and Food Science, University of Tabuk P.O. Box 699, Tabuk 71491, Saudi Arabia
[2] Department of Home Economics, Faculty of Specific Education, Kafr ElSheikh University, Kafr ElSheikh 33516, Egypt

Abstract

The aim of the current research to substitute wheat flour with millet *(Pennisetum glaucum*) flour to produce high quality and nutritional value, toast bread. Toast bread was prepared by substitution of millet flour powder at level of 15, 30 and 45 % instead of wheat flour. Chemical composition and minerals were determined and sensory evaluation was evaluated. The obtained results indicated that control was the highest in sensory properties followed by 15 % millet flour more than other levels of 30 and 45 % millet flour levels(MF). Moisture content were increased comparing with control toast bread ,the highest increased noticed in 45% millet .Fat and carbohydrates contents were decreased comparing with control , while ash and fiber content were increased comparing with control and the highest increased found in 45% millet flour toast bread. The data show increase all minerals compared with control of toast bread. Control toast bread was the highest in amino acids and fatty acids content compared with millet formula . total phenolic acids, flavonoids compound were the highest level increase by increasing level of millet flour. Millet is a good source of phenolic acids, flavonoids compound, considered as a functional food for due to health and nutritional values and its high content of protein and dietary fiber.

Introduction

Increased demand for health-promoting and disease-preventing food items, also known as functional foods, has resulted from rising consumer awareness and interest in wellness, health, and nutrition. These are foods that include bioactive components that have health advantages in addition to basic nourishment. The physiological benefits of certain functional meals can be attributed to bioactive components found in them, such as phytochemicals, dietary fibers, and proteins. Several studies have found that developing and consuming such functional meals not only improves consumers' nutritional status, but also helps to reduce the risk of certain degenerative diseases linked to modern lifestyles ***(Sun, et al 2002, Oboh, et al 2007)***. Furthermore, the use of functional food products for health management is gaining traction around the world, with reports indicating that extensive intake of functional foods could result in a 20% reduction in health-care spending.3 Bread is a fermented and leavened confectionary food made from wheat flour as the primary ingredient and additional ingredients such as yeast, salt, sugar, and water. It is commonly referred to as an important carbohydrate source on the dietary pyramid because it can provide the body requirement from nutrients . It is one of the world's most ancient and convenient foods, extensively enjoyed by the general public.

Bread is a fermented confectionery food made mostly from wheat flour, water, yeast, and salt and manufactured by a number of processes that include mixing, kneading, proofing, shaping, and baking ***(Dewettinck et al., 2008).*** Bread and other baked foods made from wheat flour, such as biscuits, doughnuts, and cakes, are quite popular, but wheat flour's low protein level, which is the most important element in the manufacturing of various baked goods ***(Young, 2001).***

As a human staple, millet is an important source of nutrition for households. Other applications include beverage manufacturing.

When compared to other cereals such as rice or maize, millet has a higher concentration of protein, fibre, and minerals such as iron and zinc. Other nutrients found in millet include vitamin B6, essential amino acids, and antioxidants. It is known that they have a low glycaemic index and are slowly digestible ***(Shobana et al., 2009).***

Chemical and nutritional properties of millet make it an excellent raw material for large-scale food manufacturing. It has a low glycaemic index, antioxidant activity, and is good for celiac disease sufferers, among other things. Pearl millet grains can be processed and consumed as ingredients in a variety of cuisines to learn more about millet's good effects on the body and its potential as a food ingredient ***(Gulia et al., 2007; Basavaraj et al., 2010).***

Because of their rich protein, fiber, mineral, and fatty acid content, as well as their antioxidant characteristics, they are referred to as "nutri-cereals." They're also a gluten-free option for celiacs and gluten-sensitive people. Whole grain products have been more popular in recent years due to their higher level of dietary fiber, minerals, and bioactive components (Gong et al., 2018). Pearl millet grains can be regarded a food diversification option because they include fibers, minerals, proteins, and antioxidants in comparable or even higher amounts than typical grains like rice and maize ***(Saldivar, 2003; Taylor, 2016). Saleh et al., 2013, Olaiya et al., 2016*** .These bioactive compounds are beneficial to human health because, among other things, they have antioxidant, anti-carcinogenic, and antibacterial properties. Natural antioxidants such as flavonoids, tocopherols, and phenolic acids may prevent lipid peroxidation in food and protect against oxidative damage caused by free radicals. ***(Huyut et al., 2017, Huyut et al., 2017).*** Antioxidants, also known as free radicals, are molecules that protect cells from the detrimental effects of reactive oxygen species (ROS) ***(Lim et al., 2006).***

The aim of this study was to standardize the formulation of fortified millet bread as well as evaluate its chemical, sensory and antioxidant properties.

Materials and Methods

Materials

Millet was obtained from a local market Kafr El-Sheikh governorate, Egypt .The skin of millet washed and dried at 63˚C using a fan oven. then ground into fine powder using a laboratory mill. The ingredients which were used in bread making were also brought from a local market. These ingredients included: wheat flour free of gluten (72% extraction rate), compressed baker's yeast, sucrose, salt and improver.

Preparing of toast bread :

The yeast and sugar were dissolved in warm water. The yeast, sugar, and little of flour mixed mechanically for 2 min and fermented for two hr. After fermentation, amount of water, salt and improver were blended substituted with wheat flour at different levels namely, 15, 30, and 45 % millet flour blended fermented again for 2 hour. Baking was run in an oven at 200 $_{o}$ C for 45 mint. After cooling for 30 mint, the toast bread was packed and used for evaluation of various physical and sensory characteristics ***(AACC, 2002).***

Methods

Gross chemical composition:

Moisture, ash, crude protein and ether extract of wheat flour, were determined according to the method of ***A.O.A.C. (2000).*** Crude fiber was determined according to the method explained by ***Kirk and Sawer, (1991)***.

Carbohydrates were calculated by difference =100- (%protein + %fat +%ash +%fiber).

Determination of some minerals:

Mineral contents of all produced products (Na, K, Fe ,Zn , Cu and Ca) were carried out in the Central Laboratory, Fac. of Agric., Kafr El Sheikh. Univ., using atomic absorption (NC.9423-400-30042) England by techniques described by ***A.O.A.C. (2000).*** **Phytochemical analysis** :Phytochemical analysis including total phenolics were determined according to the methods of ***Ling et al., (2009),*** total flavonoids according to ***Zhishen et al., (1999).***

Determination of vitamin A: was adopted using spectro-photometer method according to ***Parrish (1977).*** Determination of Vitamin E (α-tocopherol): Samples were extracted with methanol-BHT (butylhydroxytoluene) (1mg/mL) solution as described by ***(Miranda et al., 2010).*** The vitamin E content was expressed in mg/100g. ***(AOAC, 1995).*** Determination of vitamin B1 (Thiamine): The vitamin B1 content was expressed in mg/100g ***(AOAC, 1995).***

Determination of vitamin B2 (Riboflavine): The vitamin B2 content was expressed in mg/**100** ***(AOAC, 1995).*** Determination of Vitamin B3 (Niacina):). The vitamin B3 and B6 content were expressed in mg/100 g ***(AOAC, 1995).*** Amino acids content were 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).*** Fatty acid profile: Fatty acid profile was determined in toast bread and biscuits samples using gas chromatography according to ***(AOAC, 1984)***

Sensory evaluation of toast bread:

Trained twenty-member toaster consisting of staff members (female) of the Home Economics Department Kafr El-Sheikh University. The tests were performed under fluorescent lighting in a sensory evaluation laboratory. Tap water was provided to rinse the mouth between evaluations. The judges evaluated the samples for appearance, colour, flavour, texture and overall acceptability

Panelists evaluated toast bread blends on a Panelists evaluated pan bread blends on a 9 point hedonic scale quality analysis with 9 = liked extremely, 8 = liked very much, 7 = liked, 6 =liked mildly, 5 = neither liked nor disliked, 4 =disliked mildly, 3 = disliked, 2 = disliked very much and 1 = disliked extremely according to the method described by ***Larmond,1997***

Statistical analysis:

Data of sensory evaluation, chemical composition, and physical properties were subjected to analysis of variance followed by Duncan's multiple range tests according to ***Steel and Torrie (1980).***

Results and discussion

Data in table (2) showed the Sensory evaluation of different formulae toast bread fortified with millet flour (MF). taste, smell, texture, appearance ,volume and acceptability were included. ,from results it noticed that control was the highest comparative with the other formulas followed by 15 % millet flour while the lowest was observed among other levels which are 30 and 45% millet flour levels

The proximate chemical composition of millet flour toast are presented in Table (3) . As shown moisture, protein ,fat, ash, crud fiber and carbohydrates are included. Results indicated that moisture content of toast bread at different levels were increased comparing with control toast bread. The highest increased noticed in 45% millet flour while the lowest moisture content was noticed in 15 % millet toast bread .Protein , fat and carbohydrates contents were decreased comparing with control , while ash and fiber content was increased comparing with control , while highest increased found in 45% millet flour toast bread. In many poor countries, pearl millet (*Pennisetum glaucum)* is a staple crop and a major source of critical nutrients in semi-arid and desert regions of Africa. It's high in dietary protein, carbs, fat, vitamins, and minerals, especially iron and zinc.

It contains high levels of lipids, high-quality, well-balanced proteins, and phenolic substances that promote health. It is known to be healthier than most other cereals in terms of nutrition. It also responds to the increased demand for gluten-free foods and beverages from those suffering from celiac disease and other wheat intolerances ***(Kasarda, 2001).*** Antioxidant, anticarcinogenic, hypocholesterolemic, hypoglycemic, and antiulcerative qualities are all found in pearl millet. Pearl millet is appropriate for food applications such as the creation of baby and snack foods, as well as bread items, because it contains all of these essential nutrients and health-promoting characteristics ***(Saleh et al., 2013).***

Table (4) indicated that content of mineral calcium (Ca), magnesium (Mg) ,potassium (K), phosphorus (P), Zink (Zn) , iron (Fe), manganese(Mn) and sodium (Na) of toast bread enriched with MF w increased with the increasing of millet % of toast bread prepared from millet flour compared with control of toast bread. The obtained results are in agreement with the results of ***(Ibrahim 2017)*** and ***(Krishna, & Saraswat, 2020).***

Bioactive compounds found in plant dietary sources, such as, phenolics and flavonoids were determined in the formula and the results were recorded in table (5), it noticed that quantities of phenolics and flavonoids increased with increasing of the % of millet addition . malted millet could serve as good dietary source of natural antioxidants and may be considered potential functional ingredients and consequently would contribute to development of value added functional food products ***(Ibidapo. et al ., 2019).***

Amino acide content recorded in table (6) .The obtained results indicated that, the amount of total essential amino acids of millet flour blends increased with increasing amount of millet flour , the highest increased 45% toast bread. Non-essential amino acid content decreased with increasing level of substitution the highest decrease in 45% millet toast bread. total amino acid content

decreased with increasing level of substitution the highest decrease in 45% millet toast bread.

Data given in Table (7) showed the fatty acid composition (mg.100g) of millet toast bread .The obtained results indicated that decreased in total saturated fatty acids of toast bread by increasing level of added millet flour .the highest decreased noticed in 45 % millet flour toast bread .total un saturated fatty acids was the highest in millet toast bread 45% .

Data given in Table (8) showed the content of vitamins (Vitamin A, Vitamin E, Vitamin B1, Vitamin B2 , Vitamin B3, Vitamin B6) of millet toast bread , from table its noticed the highest content of vitamins noticed in control toast bread comparing with other blends. The total mineral content in pearl millets is 2.3 mg/100g which is quite high as compared to other commonly consumed cereals. It is also rich in several other vitamins like B-vitamins potassium, phosphorous, magnesium, iron,zinc, copper and manganese. ***(Adeola O, 1994).***

Table 1. Ingredients formula toast bread made from different levels of millet flour.

Ingredients	Control	Formula(1)	Formula(2)	Formula(3)
WF (72%)	100	85	70	55
Millet flour	0	15	30	45
Salt (g)	2	2	2	2
Yeast (g)	1.50	1.50	1.50	1.50
Sugar (g)	2	2	2	2
Improver (g)	3	3	3	3

Table (2) Sensory evaluation of different formulae toast bread of millet flour on dry weight.

	Sensory properties					
Treated toast Bread T	Taste (9)	Smell (9)	Texture (9)	Appearance (9)	Volume (9)	Acceptability (9)

Control	6.54± 0.38ab	6.45± 0.09ab	7.89± 0.78 a	7.83± 0.18 a	7.20± 0.76 a	7.54± 0.16 a
Toast bread 15% MF	6.89± 0.11a	6.88± 0.41a	6.50± 0.76 b	6.86± 0.28 b	6.56± 0.28 b	6.70± 0.25 b
Toast bread 30% MF	6.02± 0.05 b	6.15± 0.07 b	6.20± 0.46bc	6.13± 0.78 bc	6.29± 0.18 bc	6.05± 0.17 c
Toast bread 45% MF	5.50± 0.05 c	5.96± 0.02 c	5.87± 0.12c	5.51± 0.28 c	6.01± 0.07 c	5.51± 0.05 d

Table (3) Mean± SD of Chemical composition of different formulae toast bread of millet flour (on dry weight).

	Chemical composition					
Treated Toast bread	Moisture	Protein	Fat	Ash	Fiber	Carbohydrates
Control	34.34± 0.12	14.83± 0.10	2.86± 0.05	1.19± 0.03	1.86± 0.05	46.80± 0.10
Toast bread 15% MF	34.82± 0.09	14.55± 0.12	2.60± 0.03	1.64± 0.03	2.11± 0.03	46.38± 0.15
Toast bread 30% MF	35.34± 0.09	14.42± 0.86	2.43± 0.04	2.13± 0.03	2.48± 0.02	45.66± 0.11
Toast bread 45% MF	36.22± 0.08	14.36± 0.07	2.31± 0.04	2.25± 0.03	2.83± 0.03	44.84± 0.02

Table (4)) Mean± SD of Mineral contents (mg/100g) of different formula levels of millet toast bread.

Minerals	Formula toast bread			
	Control	Toast bread 15% MF	Toast bread 30% MF	Toast bread 45% MF
Ca	28.06±0.43	31.21±0.48	34.05±0.52	36.12±0.55
Mg	106.40±1.37	121.2±1.57	138.3±1.79	153.5±1.99
K	127.9±1.77	131.3±1.82	168.0±2.33	189.1±2.62
P	113.01±1.70	110.20±1.67	109.01±1.65	106.30±1.60

Zn	1.173±0.05	1.23±0.02	1.39±0.02	1.52±0.02
Fe	2.48±0.03	3.07±0.04	3.86±0.05	4.10±0.05
Mn	0.95±0.04	1.12±0.01	1.34±0.02	1.53±0.02
Na	194.2±2.78	196.1±2.57	211.1±2.90	215.2±3.48

Table (5) Mean± SD of total phenol and total flavonoids of different formula levels of millet toast bread.

Antioxidants	Formula toast bread			
	Control	Toast bread 15% MF	Toast bread 30% MF	Toast bread 45% MF
Total Phenols	5.60±0.17	9.17±0.12	12.26±0.16	16.73±0.23
Total Flavonoids	86.38±1.06	94.93±1.17	98.18±1.21	121.20±1.49

Table (6) Amino acids % in different formula levels of millet toast bread (g/100g of sample)

Amino acids content	Formula toast bread			
Amino acids (%)	Control	Toast bread 15% MF	Toast bread 30% MF	Toast bread 45% MF
Essential amino acid	32.86	33.23	33.46	33.61
Non-essential amino acid	63.71	63.19	62.81	62.48
Total amino acid	96.57	96.42	96.27	96.09

Table (7) Fatty acids profile in different formula levels of millet toast bread (mg/100g)

Formula toast bread				
Fatty acids	Control	Toast bread 15% MF	Toast bread 30% MF	Toast bread 45% MF
Capryic	-	-	-	-
Caprylic	-	0.01	-	-
Lauric	0.03	0.01	-	-
Myristic	0.21	0.12	0.09	-
Palmatic	2.41	2.62	2.31	1.89
Stearic	2.09	1.91	1.73	1.08
Total saturated	4.74	4.67	4.13	2.97
Oleic (omega 9)	2.13	2.53	2.44	2.61
Linoleic (omega 6)	1.99	1.73	1.94	1.79
Arachidonic	-	-	0.01	-
Linolinic (omega 3)	0.11	0.18	0.16	0.23
Total un-saturated	4.23	4.44	4.55	4.63

Table (8) Vitamins content profile in different formula levels of millet toast bread (mg/.100g).

	Formula toast bread			
Vitamins	Control	Toast bread 15% MF	Toast bread 30% MF	Toast bread 45% MF
Vitamin A (IU)	0.36	0.21	-	-
Vitamin E (mg.100g)	10.16	10.32	10.01	9.36
Vitamin B1 (mg.100g)	1.18	1.09	1.02	0.98
Vitamin B2(mg.100g)	0.36	0.31	0.25	0.11
Vitamin B3 (mg.100g)	2.21	2.03	1.86	1.31
Vitamin B6 (mg.100g)	0.89	0.73	0.36	-

Conclusion

The major goal of this research was to create a nutritious toast bread with various health benefits and make it available to consumers as a healthy option. The toast bread is a safe to eat by anyone, whether they are sick or healthy. Because its healthful, it can be taken by people of all ages. The substitution of pearl millet flour for refined wheat flour improved the nutritional and sensory qualities of the toast bread. It may be stated that incorporating functional foods into one's diet is a positive step toward better nutrition.

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الأستفادة من دقيق الدخن فى إنتاج خبز التوست خالى الجلوتين

نـهله صلاح زيدان[١-٢]

قسم التغذية وعلوم الاطعمة – جامعه تبوك - المملكة العربية السعودية

كليه التربية النوعية - قسم الاقتصاد المنزلي - جامعة كفر الشيخ – مصر

الملخص العربى

يهدف البحث الحالي إلى استبدال دقيق القمح بدقيق الدخن (*Pennisetum glaucum*) لإنتاج خبزتوست عالي الجودة و عالي القيمة الغذائية من دقيق الدخن MF منخفض في نسبة الجلوتين. تم تحضير خبز التوست باستبدال مسحوق دقيق الدخن بنسب ١٥ و ٣٠ و ٤٥٪ كمصدر غني بالألياف والعناصر المعدنية . تم تقدير التركيب الكيميائي والمعادن و التقييم الحسي ايضا تم تقدير الاحماض الامينية والاحماض الدهنية والفيتامينات والمواد المضادة للاكسدة . أشارت النتائج المتحصل عليها إلى أن الخبز التوست الكنترول كان الأعلى في الخواص الحسية مقارنة مع النسب الأخرى يليها خبز دقيق الدخن بنسبة ١٥٪ كان الأفضل مقارنة بباقي النسب ٣٠

و ٤٥٪ . لوحظ ايضا زيادة المحتوى الرطوبي والرماد والالياف في الخبز المدعم بالدخن ،وكانت اعلى النسب زيادة نسبة ٤٥% بينما انخفض محتوى البروتين والدهون والكربوهيدرات وكان اعلى انخفاض في الخبز المدعم بالدخن بنسبة ٤٥% . ايضا تشير النتائج الى زياده العناصر المعدنية بشكل ملحوظ في جميع الخلطات المحتوية على الدخن وكانت اعلى زيادة في الخبز المدعم بالدخن بنسبة ٤٥% . ايضا تم تقدير الاحماض الامينة والدهنية ولوحظ ان اعلى القيم لوحظت في الخبز التوست الكنترول مقارنة بباقي الخلطات ، سجلت خلطات الخبز المدعم بالدخن اعلى القيم في محتواها من المواد الفينولية و مركبات الفلافونويد وكانت اعلى النسبة الخبز المدعم بالدخن نسبة ٤٢ ٪ لذا يعتبر الدخن مصدرًا جيدًا للأحماض الفينولية ومركب الفلافونويد ، وهو غذاء وظيفي نظرًا لقيمته الصحية والغذائية ومحتواه العالي من العناصر والألياف الغذائية.