Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Microbial and Mineral Composition of Fortified Food From Flour Blends of Malted Sorghum, Yellow Maize and Tigernut

By

[1]Odion-Owase, A and [2]Odion-Owase, E

[1]Department of Biological Science Laboratory Technology, Auchi Polytechnic, Auchi.

[2]Department of Food Technology, Auchi Polytechnic, Auchi.

e-mail-bimbo.owase@gmail.com

Abstract

This research was carried out to determine the microorganisms and mineral composition of fortified food from flour blends of malted sorghum, yellow maize and tigernut. Three samples of the fortified foods were produced at different ratio of formulation and labeled as samples A, B and C. Sample A had 50% yellow maize, 30% malted sorghum and 20% tigernut. Sample B had 60% yellow maize, 25% malted sorghum and 15% tigernut, while sample C had 70% yellow maize, 20% malted sorgum and 10% tigernut.*Streptococcus lactis, Lactobacillus* speciesand *Saccharomyces cerevisae* were isolated from the samples. The microbial counts were not significant; however, there were significant difference ($P<0.05$) in the microbial counts of the samples. Potassium, calcium, sodium and phosphorous were present in high quantities in all the samples. Potassium was the highest mineral while iron was the least mineral present in all the samples.

Keywords: Malted, Fortified, Microorganisms, Sorghum

Introduction

Nutritional demand of Nigerians is changing in response to the trend in other parts of the world in order to check emerging diseases and to avoid or manage some other health conditions. This change has a shift from synthetic products to natural, fresh and plant-based products. This situation had led to sourcing for alternative in plant to produce the needed nutrients, minerals and vitamins.

Sorghum is an ancient cereal grain belonging to the grass family, Poaceae. There are many species of sorghum, the most popular being sorghum bicolor, which is native to Africa. Although Sorghum is less known in the Western world, it's the fifth most produced cereal crop in the world, with an annual production of around 57.6 million tons. Farmers favor this crop due to its tolerance to drought, heat and various soil conditions. The increased use of sorghum as a food in Sub-saharan Africa could alleviate the problem of chronic under-nourishment, as Sorghum is much better suited to cultivation in Semi-Arid tropics (SAT) of Africa, than non-indigenous cereals such as wheat or maize (Okolo and Ezeogu, 1996). Sorghum is rich in a variety of nutrients, including B vitamins, which play an essential role in metabolism, neural development, skin and hair antioxidants like flavonoids, phenolic acids and tannins. Also, it is rich in protein.

Malting has been identified as a traditional processing technology that could possibly be used to improve the nutritional quality of the protein The process of malting comprises three-unit operations, viz steeping, germination and drying. A number factors are known to have an effect on the development of enzymes synthesized during germination and thus on the quality of the malt produced
(Mertz, *et. al,* 1984).

Maize (*zeamays*) is one of the world's most popular cereal grains. It's the seed of a plant in the grass family, native to central America but grown in countless varieties worldwide. Maize contains a number of important B vitamins, vitamin C, E and vitamin A. Maize is also a good source of dietary fibre and protein but low in fat (Enyisi, et. al; 2014). Maize grain is rich in starch (60 – 75%) and is an excellent source of minerals. The protein content (9 - 12%) of maize is relatively low and it does not provide the essential amino acids since it is relatively low in lysine (Olaonipekun, *et. al,* 2015).

Tigernut (*Cyperus esculentus*) is commonly known as earth almond, tigernut, chirta, yellow nutsedge and zulunuts. It is known in Nigeria as "aya" in Hausa "Ofio" in Yoruba ad "Akihausa" in Ibo. There are three varieties (black, brown and yellow), but only two varieties (yellow and brown) are readily available in te market. Tigernut is a tuber rich in energy, mineral (mainly phosphorus and potassium) and vitamin E and C thus suitable for the diabetics. (Dianne, 2004).

The objective of this research was to determine the microorganisms and mineral composition of fortified food produced from malted sorghum, yellow maize and tigernut flours.

Materials and Methods

Sample Collection:

200kg each of Sorghum, yellow maize and tigernuts were purchased in Jattu market in Etsako West Local Government Area of Edo State, Nigeria. The samples were transported to processing workshop in the Department of Food Technology, Auchi Polytechnic, Auchi for processing.

Production and Formulation of Samples:

The raw materials were sorted, clean, washed and dried. The Sorghum was processed by malting for 72 hours at room temperature and made into powder form after sundrying.

The yellow maize and tiger nuts were made into powder form after sundrying and grinding.

Three different formulations were made at different ratios and labeled as samples A, B and C.

Sample A had 50% yellow maize, 30% malted sorghum and 20% tigernut flours.
Sample B had 60% yellow maize, 25% malted sorghum and 15% tigernut flours.
Sample C had 70% yellow maize, 20% malted sorghum and 10% tigernut flours.

The samples were formulated and fortified into finished product and packaged.

Microbial Analysis

Microbial analysis was carried out on the samples following standard procedures. Nutrient agar and Mac Conkey agar were used for the isolation of bacteria using the incubator at 37^{o}C for 24 hours. Potato dextrose agar was used for the isolation of fungi at room temperature.

Mineral Analysis

Mineral content of the three samples were evaluated according to AOAC, 2019. The mineral composition (potassium, sodium, calcium, magnesium, phosphorus, iron and zinc)of each sample was determined by ashing method followed by reading of the level of mineral.

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA) and separation of means using a pre-packaged computer software (MINITAB 15).

Results

Table 1 - Isolated Microorganisms from Samples

Sample	Bacteria	Fungi
A	*Lactobacillus* species *Streptococcus lactis*	*Saccharomyces cerevisae*
B	*Streptococcus lactis*	*Saccharomyces cerevisae*
C	*Lactobacillus* species	*Saccharomyces cerevisae*

Samples:

A = 50% yellow maize, 30% malted sorghum and 20% tigernut.
B = 60% yellow maize, 25% malted sorghum and 15% tigernut.
C = 70% yellow maize, 20% malted sorghum and 10% tigernut.

Table 2: Microbial mean counts of Samples

Sample	Bacteria mean count (Cfu/g	Fungal mean count (Sfu/g)
A	$1.6^{a} \times 10^{6} \pm 0.05$	$1.2^{ab} \times 10^{6} \pm 0.02$

B	$2.1^{b} \times 10^{6} \pm$ 0.05	$1.3^{bc} \times 10^{6} \pm$ 0.01
C	$2.0^{c} \times 10^{6} \pm$ 0.05	$1.6^{cb} \times 10^{6} \pm$ 0.05

Means with same superscript down the column are not significantly different (P<0.05)

Samples:

A = 50% yellow maize, 30% malted sorghum and 20% tigernut.
B = 60% yellow maize, 25% malted sorghum and 15% tigernut.
C = 70% yellow maize, 20% malted sorghum and 10% tigernut.

	Samples		
Parameters (100g/mg)	A	B	C
Calcium	$34.23^{a} \pm 0.01$	$36.31^{b} \pm 0.01$	$37.42^{c} \pm 0.01$
Potassium	$56.21^{ab} \pm 0.02$	$54.73^{ac} \pm 0.02$	$53.14^{bc} \pm 0.05$
Phosphorus	$12.86^{bd} \pm 0.02$	$12.43^{db} \pm 0.02$	$12.61^{cd} \pm 0.03$
Sodium	$17.93^{cb} \pm 0.01$	$17.20^{ca} \pm 0.05$	$17.46^{ba} \pm 0.05$
Magnesium	$2.71^{dc} \pm 0.03$	$2.63^{e} \pm 0.02$	$2.48^{f} \pm 0.03$
Iron	$0.36^{ec} \pm 0.01$	$0.28^{ef} \pm 0.01$	$0.32^{de} \pm 0.02$
Zinc	$0.39^{fa} \pm 0.05$	$0.26^{fc} \pm 0.02$	$0.28^{fb} \pm 0.02$

Value with same superscript in the same column are not significantly different (P<0.05)

Samples:

A = 50% yellow maize, 30% malted sorghum and 20% tigernut.

B = 60% yellow maize, 25% malted sorghum and 15% tigernut.

C = 70% yellow maize, 20% malted sorghum and 10% tigernut.

Discussions

The result of the microbial evaluation of samples revealed the presence of *Lactobacillus* species in samples A and C, *Streptococcus lactis* was also isolated from samples A and B. *Saccharomyces cerevisae* was also isolated in all the samples. All the microorganisms isolated were not pathogenic but are useful to the human system as they also act as probiotic microorganisms. The presence of these microorganisms could be attributed to malting of sorghum and processing of the flours. The bacterial mean counts of the samples ranged from 1.6 x 10^6Cfu/g to 2.1 x 10^6 Cfu/g while the fungal mean counts ranged from 1.2 x 10^6Sfu/g to 1.6 x 10^6 Sfu/g.

Sample A had the least bacterial counts. Sample C had the highest fungal count, while sample A had the least fungal count .There were significant difference ($P<0.05$) in the bacterial and fugal counts of the samples. However, the microbial count was not significant.

Potassium was the highest mineral found in all the samples while zinc was the least mineral found in all the samples. All the samples were rich in essential minerals like calcium, phosphorous and sodium. All the samples contained high calcium which play important role in strengthening the tissues and boosting bone health of the body. Potassium helps to reduce the tension in the blood vessels. It also helps to boost brain function. Phosphorus helps in dental care.

Conclusion

The fortified food produced from flour blends of malted sorghum, yellow maize and tigernut was hygienic for consumption and free from pathogenic microorganisms. The microorganisms isolated were beneficial to human as they exhibit probiotic potentials. The foods produced were also rich in minerals like potassium, calcium, sodium and phosphorous. These minerals are very essential in the body.

Recommendation

This food can be produced locally at homes and food industries to produce the necessary minerals neededfor body growth and development. It can also be a source of employment and revenue generation.

Acknowledgement

We specially thank Tetfund for sponsoring this research work and for promoting research in the country leading to national development and new discoveries.

References

AOAC, (2019) Association of Official Analytical Chemistry. Official Method of Analysis. 21st Edition, Washington, D.C

Dianne (2004): Nutritive value of potential complimentary foods based on

Tigernut and maize. Nutritional food Sci. 3:187.

Enyisi, I. S, Umoh V. J., Whong C.M.Z., Abdulahi, I. O. Alabi, O. (2014) Chemical and Nutritional Value of Maize and Maize products obtained from selected markets in Kaduna State, Nigeria. *African Journal of Food Science and Technology,* 5(4):100-104.

Iwe, M. O. (2001). Organoleptic assessment of extruded blend of soy and sweet Potato flour by response surface analysis. Plants Foods for Human Nutrition 60: 1-14.

Mertz, E. T., Hassan, M. M. Caims – Wittern, C. Kirleis, A. W. TU, I and Axtell, I (1984). Pepsin digestibility of proteins in Sorghum and other major cereals. Proceedings of the National Academy of Sciences of the United State of America 81. 1-2.

Okolo, B. N. and Ezeogy, I. I. (1996) Enhancement of amylolytic potential of Sorghum malts by alkaline step treatment. *Journal of the Institute of Brewing* 102, 277 – 284.

Olaonipekun, O T. Olapade, O. A., Suleiman, P. Ojo, S. O. (2015) Nutrient and Sensory analysis of abari made from composite mixture of kidney beans flour. *Sky Journal of Food Science,* 4(2): 019-023.

