Formulation of Healthy Foods from Maize Grain, Pulse and Banana Fruit for Preventing Acute Malnutrition

Tamiru Yazew*

Department of Food and Nutritional Sciences, Wollega University, Shambu, Ethiopia

Corresponding Author*

Tamiru Yazew

Department of Food and Nutritional Sciences,

Wollega University,

Shambu, Ethiopia

E-mail: tamiruyazew2012@gmail.com

Received date: March 26, 2021**; Accepted date:** April 09, 2021**; Published date:** April 16, 2021

Abstract

Objective: This study was designed to formulate healthy foods from grain, pulse and fruit to track the problem of acute malnutrition. Maize, soybean and banana were used as sample ingredients.

Methods: The study used maize grains, soybean, banana fruit and soya oil and sugar ingredients for the formulation of ready to use therapeutic foods. Three different food samples (HF1, HF2 and HF3) were formulated and the samples were then transferred into airtight plastic containers for further analyses. A CRD with two replications was used. Data was analyzed using ANOVA.

Results: This study shows that there was statistical significance difference among the three products in terms of appearance and consistency. The study also showed that the protein content of the three products g/100 g met the proposed nutrient composition range for plumpy' nut. Concerning, the energy, HF1 and HF2 had higher energy, which was 620 and 585, respectively compared to the plumpy' nut (545) but the HF3 had lower energy.

Conclusion: This study concluded that the ingredients that were used in the formulation of the three products were rich energy, minerals and vitamins. Therefore, it is crucial to increase the shelf life of the new developed products through further research.

Keywords: Protein energy malnutrition • Acute malnutrition • Healthy foods

Abbreviations

HF: Healthy Foods; G: Germinated; NG: Non Germinated; MAM: Moderate Acute Malnutrition

Introduction

Acute malnutrition among young children is a serious problem in the developing world, mainly disturbing the poor communities [1]. It happens when nutrients required for the body is less or excessive [2]. There are also factors which make young children more susceptible to malnutrition; poor diet intake, inappropriate child caring and feeding practices, and unfair dish sharing within the households [3].

Food and Agriculture Organization in 2011 estimated that among 12 million children died yearly, more than half (50%) of these cases were credited to protein energy malnutrition [4]. Globally, about 52 million children were wasted. It was also reported that the problem of acute malnutrition arises when child starts complementary feeding and its prevalence was 21% in Sub-Saharan Africa.

Poverty and food insecurity problems extremely limit the household capacity to purchase healthful diets such as high pulses which good protein quality, sufficient minerals and vitamins content. Ready to use health diet could be formulated from locally affordable grains, pulses and fruits which are within the accessibility of all the people and equally contain the required quantity of nutrients as well. Thus healthy foods could be the best in the management of outpatient care or home based treatment of MAM children [5]. Ready to use foods formulated from locally affordable ingredients has been highly effective to ensure various forms of acute malnutrition, including kwashiorkor, nutritional marasmus, and several forms of wasting [6]. Thus, stimulated, high energy and ready to eat foods are suitable for management of severe acute malnutrition. Formulation of healthy food from locally available ingredients and provide it for malnourished children is better at home than in hospitals [7]. Because, it could be easily made by mothers or manufactured at commercial level in the form of healthy foods.

Cereal based healthy food formulation with awareness creation among communities is a solution to prevent protein energy malnutrition among young children in developing countries [7]. Therefore, the objective of this study was initiated to formulate affordable, nutrient dense healthy foods from maize grain, soybean and banana fruit for the management of severely malnourished children.

Materials and Methods

Materials

The study used maize grains, soybean, banana fruit, and soya oil and sugar ingredients for the formulation of ready to use therapeutic foods.

Preparation of samples/ingredients

The malted maize grain and soybean flour were prepared according to the producers of studies done elsewhere [8,9]. The banana fruit samples were also collected from the market and further processed according method above [9].

Formulation of the healthy foods and experimental procedures

The guideline was used to formulate healthy foods from locally available ingredients by considering F100 nutrient information [10]. Three different food samples (HF1, HF2 and HF3) were formulated and the samples were then transferred into airtight plastic containers for further analyses. The samples coded in three digits were randomly assigned to the samples and sample arrangements were also randomized for each panelist. The amounts of ingredients were calculated on dry weight basis, for the formulation of RUTFs. The maize grains, soybean, banana, soya oil, vitamin, minerals and sugar as a sweetening agent were used to formulate the RUTFs. Thus, three products were developed on the basis of WHO/UN specification of RUTFs. The ingredients content in each product is given in the below Table 1. Product-1 (HF1) and product-2 (HF2) had the same ratio of maize and soy bean. However, HF1 was formulated from non-germinated ingredients while, HF2 from germinated ingredients. Product-3 (HF3) was formulated from mixes of both germinated and non-germinated raw materials on equal basis.

Table 1. Formulae mixes on dry basis.

Ingredients	HF1	HF2	HF3
Maize (g)	28	28	0
Soybean (g)	30	30	55
Banana (g)	25	0	0
soy oil (g)	15	15	15
Sugar (g)	28	25	28
Mineral mix (g)	2	2	2
Total	100	100	100

Experimental design

A completely randomized design approach was used with two replicates.

Proximate and mineral analysis

The proximate analysis of the samples was determined using the Association of Official Analytical Chemist procedures. The moisture content was determined using oven. The Kjedahl method was also used to determine protein content of the samples. Fat was determined by the Rose-Gottlieb method [11].

Ash was determined by dry ashing method by placing the sample in a muffle furnace and ignited for twelve hours at 550°C. Carbohydrate was determined by calculating the percent difference after moisture; protein, fat and ash were measured. Minerals like iron, manganese, calcium and zinc were determined by the Atomic Absorption Spectroscopy (AAS).

Determination of phytate and tannin content

Phytate and tannin content of the samples were determined using according the procedure of previous studies done [12,13].

Phytic acid

(mg/100 g)=(absorbance-inercept)/slpoe × density × wt of the sample × 10

Tannin(mg/100 g)=(absorbance-inercept)/slpoe × density × wt of the sample × 10

Sensory evaluation of the formulated healthy foods

The three formulated health foods from affordable ingredients with its two replications were subjected to consumers to rate their degree of liking or disliking [14]. Samples were labeled with three digit blinding codes and samples were also randomized for each panelist. About 25 mothers who had young children were participated in the sensory evaluation of newly formulated products at the Laboratory of Food and Nutritional Sciences, Wollega University.

Statistical analysis

The data gathered on the acceptability test using the questionnaire designed for the samples were analyzed using SPSS version 20.0. The samples' differences and ranking were determined using descriptive analysis and ANOVA. Analysis of variance was employed on the samples means of the 9-point hedonic scale on the attribute of concern: Appearance, consistency, sweetness and taste. Statistical significance on the attributes were further analyzed to see where mean differences existed using Post Hoc Test-LSD.

Results and Discussion

Sensory evaluation

The recent uses of affective analysis or hedonic test in consumer preferences have been established to be highly efficient tool in product development and production that will sell in substantial quantities or permit higher pricing. Product 3 (HF-3) was most preferred in terms of consistency (7), sweetness (7) and flavour/taste (7). But the flavor/taste was highly rated among the three samples (Table 2).

Table 2. Average and mean acceptability scores of the products.

Attributes	HF1 (mean)	HF2 (mean)	HF3 (mean)	P value
Appearance	6 (6.2)	8 (7.82)	7 (7.44)	0.03
Consistency	6 (6.14)	6 (6.2)	7 (7.5)	0.02
Taste	7 (7.43)	7 (7.42)	7 (7.98)	0.23
Flavour	7 (6.68)	7 (7.44)	7 (7.3)	0.12
Overall	27 (26.45)	28 (28.88)	28 (29.52)	

The varied choice of the attributes resulting in the highest and least preferred of the product might be as a result of the diverse cultural backgrounds, experiences, attitudes and habits of respondents. The overall average based on the attributes such as appearance, consistency, sweetness and flavour of HF-1, HF-2 and HF-3 were 27, 28, 28, respectively (Table 2). This suggests that P-2 and P-3 had the highest respective averages on the attributes ranked with the 9-Point Hedonic scale. The ANOVA findings revealed that there was statistical significance among the three products in terms of appearance (p=0.03) and consistency (p=0.01) (Table 2). This could be attributed to the considerable difference particularly in the quantities of banana and water used. However, this finding indicated that there were no statistical significance differences in sweetness and flavor/taste among the three products HF-1, HF-2 and HF-3. This could be attributed to the fact that they were made from the same ingredients and their respective proportions of the ingredients for the formulation of the each of the product were not much.

Nutrient content of formulated health foods

This study finding revealed that the protein content of the three products (HF1, HF2 and HF3) g/100 g met the proposed nutrient composition range for plumpy' nut. Concerning the energy, HF1 and HF2 had higher energy, which was 620 and 585, respectively compared to the plumpy' nut (545) but the HF3 had lower energy.

The findings of this study also found that the fat content of HF2 and HF3 had higher compared to the plumy' nut (Table 3). Generally, it indicates that the ingredients that were used in the formulation of the three products were rich in macro nutrients and provides high kilocalories.

Table 3. Comparison of the major nutrient, moisture content and energy of developed ready to use therapeutic foods with plumpy'nut.

Major nutrients	HF1	HF2	HF3	Plumpy'nut (HF4)
Protein (g/100g)	15.62	18.12	14.21	13.6
Energy (Kcal/100g)	620	585.4	521	545
Carbohydrate (g/100g)	15.7	20.23	17.5	-
Fat (g/100g)	27.12	39.84	36.32	35.7
Moisture (g/100g)	79.8	68.5	73.2	-

Mineral content of formulated health foods

Regarding the mineral, the iron and magnesium content of HF2 and HF3 had higher compared with plumpy' nut but that of HF1 was lower. According to the finding of this study, the zinc content of the HF1 and HF3 was also higher compared to the plumpy' nut. Moreover, this study reported that the potassium and calcium content of the HF2 were higher compared to that of the plump'y nut (Table 4).

Table 4. The mineral content of formulated Health foods (RUTFs) with plumpy' nut.

Minerals	HF1	HF2	HF3	Plumpy'nut (HF4)
Iron (mg/100 g)	10.2	12.4	14.3	11.5
Zink (mg/100 g)	18	11	21	14
Potassium (mg/100 g)	1,034	1,212	1,092	1,111
Magnesium (mg/100 g)	88	112	104	92
Calcium (mg/100 g)	280	312	245	300

Anti-nutritional factor analysis of the samples

The formulated HF1 contained 379.30 mg/100 g phytate. The phytate content of HF1, HF2 and non-germinated had 343.63 mg/100 g and 334.74 mg/100 g, respectively. The phytate content of the germinated samples was lower than non-germinated before processing. The finding of this study also shows that the tannin content of HF1, HF2 and non-germinated samples was 173.55 mg/100 g and 102.36 mg/100 g, respectively. The tannin content of the germinated samples was significantly lower than non-germinated before processing (Table 5).

Table 5. Anti-nutritional factor content of the developed ready to use therapeutic food samples.

Anti-nutritional factor content	Phytate (mg/100 g)	Tannin (mg/100 g)
HF1 (NG)	379.30 ± 0.39	173.55 ± 0.35
HF2 (NG)	343.63 ± 0.29	102.36 ± 0.46
HF3 (G)	334.74 ± 0.42	121.21 ± 0.11

Abbreviations: NG: Non-Germinated; G: Germinated

Conclusion

The findings of this study concluded that that there was statistical significance in appearance (p=and consistency among the three products (HF1, HF2 and HF3). The study also showed that the protein content of the three products g/100 g met the proposed nutrient composition range for plumpy' nut. This finding is also found out that HF1 and HF2 had higher energy compared to the plumpy' nut (545). Besides, the finding of this study showed that the fat content of HF2 and HF3 had higher compared to the plumy' nut.

Moreover, the iron and magnesium content of HF2 and HF3 had higher compared to plumpy' nut while the zinc content was higher in HF1 and HF3. Furthermore, the study revealed that that the phytates and tannin content of the malted samples was significantly lower than non-malted. Therefore, it is important to alleviate the shelf life of the formulated products and ensure their energy density through further researches.

Ethics Approval

The ethical clearance was obtained from the Institutional Review Board (IRB) of the college of medicine and health sciences of Wollega University (Ref-WU: 117, 268-Re21). Informed written consent was obtained from participants prior to collect data from them. The purpose of this study was explained at all levels and informed consent was secured from each participants.

Acknowledgements

The author would like to thanks Wollega University, Research and Innovation Technology for fund security.

Disclosure

The author declares that there were no potential conflicts of interest for this work.

References

1. Poel, E.V., N et al. "Socioeconomic inequality in malnutrition in developing countries." *Bulletin World Health Org* 86(2008): 282-291.
2. Manary, M.J. "Manangment of acute and severe childhood malnutrition." *BMJ* 337(2008): a2180.
3. Debelew, G.T., et al. "Determinants and causes of neonatal mortality in Jimma Zone, Southwest Ethioipia: A multilevel analysis of prospective follow up study." *Plos One* 9.9(2014): e107184.
4. World Food Programme. "The state of food insecurity in the world 2012." *FAO Adv Nutrition* 4.1(2013): 126-127.
5. Wagh V.D., & Deore, B.R. "Ready to use therapeutic food: An overview." *Adv Life Sci Health* 2.1(2015).
6. Munthali, T., et al. "Mortaility and morbidiy patterns in under five children with Severe Acute Malnutrition (SAM) in Zambia: A five years retrospective review of hospital based records (2009-2013)." *Arch Public Health* 73(2015):23.
7. Schoonees, A., et al. "Ready to use therapeutic food for home based treatment of severe acute malnutrition in children from six months to five years of age (review)." *Cochrane Database Sys Revi* 6(2013).
8. Ndife, J., et al. "Production and comparative quality evaluation of Chin-Chin Snacks from maize, soybean and orange fleshed sweet potato flour blends." *FUDMA J Sci* 4.2(2020): 300-307.
9. Makinde. F.A., et al. "Cumulative production forecast of oil well using simplified hyperbolic-exponential decline models." *Global J Res Eng* 12.2(2012).
10. Manary, M.J., et al. "Home based therapy for severe malnutrition with ready-to use food." *Arch Dis Child* 89(2004): 557-561.
11. AOAC. "Official methods of analysis of AOAC international." *AOAC Int* (2000).
12. Latta, M., & Eskin, M. "A simple and rapid colorimetric method for phytate determination." J *Agric Food Chem* 28(1980): 1313-1315.
13. Maxon, E.D., & Rooney, L.W. "Evaluation of methods for tannin analysis in sorghum grain." *Cereal Chem* 49(1972): 719-729.
14. Harry, T., & Lawless, H. "Sensory evaluation of food: Principles and practices." (2010).

Cite this article: Yazew T. Formulation of Healthy Foods from Maize Grain, Pulse and Banana Fruit for Preventing Acute Malnutrition. J Biol Today's World, 2021, 10(4), 001-003.