African Journal of Food Science and Technology (ISSN: 2141-5455) Vol. 3(10) pp. 236-243, December, 2012
Available online http://www.interesjournals.org/AJFST

Full Length Research Paper

Effect of added beneseed paste on the quality of millet-based masa

[*1]Ayo J.A, [1]Onuoha G, [1]Agu H, [1]Ayo V.A, [1]Avu E.O, [2]Sosanya M, and [2]Adeosun F

[1]Department of Food Science and Technology
[2]Department of Nutrition and Dietetics, the Federal Polytechnic, PMB 0231, Bauchi

Accepted November 15, 2012

Beneseed enriched millet masa was produced using millet and beniseed flour. The millet was cleaned, washed, dried, dehulled and dry-milled to produce flour. Beneseed was washed, dried and toasted and milled to produce flour. Beneseed flour was supplemented into the millet flour at 0, 10, 20, 30, 40 and 50%. Millet –Beneseed composite masa was produced using the local method and analyzed for proximate, sensory and microbial qualities. The protein and the fat content increased from 8.88 - 11.20% and 9.44 - 11.50%, respectively, while the ash, moisture and carbohydrate decreased from 2.6 -1.0%, 3.8 - 1.8% and 75.32 - 74.44% respectively with increase in the added beneseed flour(0 – 50%). The average mean score for taste, colour, texture, aroma, appearance and general acceptability decreased from 5.10 – 4.45, 5.55 – 5.0, 6.45 – 4.5, 5.70 – 4.95, 5.05 – 4.15 and 6.05 – 5.0, respectively with increase in added beneseed flour. The sample with 20% beneseed and 80% millet with corresponding increase in protein content (14.3%) was the most accepted by the consumers. The microbial counts obtained showed a reduction in microbial populations from 5.0 x 10^5 to 1.0 x 10^5 for bacteria and 6.0 x 10^6 to 1.0 x 10^5 for fungi with increase in added beneseed flour (0-50%). The organisms identified were Bacillus spp., *Streptobacillus spp., Staphylococcus spp., and Streptococuss spp.*, for bacterial and *Saccharomyces spp., Penicillum spp., and Aspergillus spp.*, for fungi.

Keywords: Beneseed flour, millet, bacterial and carbohydrate.

INTRODUCTION

Masa (Waina) is a fried round shaped fermented bread-like product that is round in shape and made from the batter of rice, pearl millet or maize. It is like the Indian idli in shape and dose in taste (Nkama and Malleshi, 1998) but different from the Mexican "*Masa*" used in tritiller preparation. *Masa* is a popular staple food consumed by over 80% of the Northern Nigerian population of about 47 million (Nkama, 1993). It is also consumed in Niger, Burkina Fas and Mali (Nkama, 1998). It is prepared to create variety in cereal based foods for sale and serves as a breakfast and snack item. Though it is as popular as the Nigerian Ogi, but has only received very little attention (Nkama and Malleshi, 1998).

Masa is one of the major sources of carbohydrate to the natives of the indigene states in the North. It contains protein, oil, starch, calcium and phosphorus. *Masa* is a food used for breakfast forming $^1/_5$ of the then total daily intake as recommended by FAO/WHO/UNU. The energy content of formulated masa samples was within the recommended values (Nkama and Malleshi, 1998).

In the preparation of Masa, the raw materials commonly used include:- Millet, rice, salt, sugar, yeast, vegetable oil and trona or 'kanwa'. During preparation of masa from pearl millet the grain is dehulled, washed, dried and grounded. The grounded masa is then sieved to produce grits and flour of which the grit is added to boiling water and cooked before mixing with the raw flour in the ratio of 1:2.

The batter obtained, is inoculated with baker's yeast and allowed to ferment over night (14-16 hrs). This fairly thick batter is then diluted with trone or 'kanwa' water. Salt and sugar is added to the batter and stirred vigorously to incorporate air. The batter is scooped using a medium sized spoon (50ml capacity) and placed in a pan with individual cup-like depressions in which vegetable oil (3-5 ml) has been added. Batter is fried for 2 minutes on one side, then turned with a small spoon and the other side fried (Nkama and Malleshi, 1998).

*Corresponding Author E-mail: jeromeayo@yahoo.com

Table 1. Recipe for Production of Composite Masa

Raw materials (g)	qr	zt	vu	Xy	yz	wz
Millet	100	90	80	70	60	50
Beni seed	0	10	20	30	40	50
Water	75	75	75	75	75	75
Sugar	9.3	9.3	9.3	9.3	9.3	9.3
Trona	3	3	3	3	3	3
Yeast	0.5	0.5	0.5	0.5	0.5	0.5
Oil (G/nut)	5	5	5	5	5	5
Salt	Pinch	Pinch	Pinch	Pinch	Pinch	Pinch
Baking powder	0.5	0.5	0.5	0.5	0.5	0.5

Masa is a single cereal food whose protein is very poor in nutritional quality and commonly deficient in the essential amino acids such as lysine. It is therefore very important to supplement with locally available legumes and oilseeds that are high in protein and lysine such as groundnut paste, cowpea, beniseed.

Beniseed an important edible oil seed crop is produced in several states of Nigeria such as Kaduna, Benue, Kogi, Nassarawa, Niger, Taraba, Yobe, Cross-River and Jigawa (Sosanya, 2007). Beniseed (sesame) are used as a soup mickering condiment and as an important dietary source of protein in areas where they are grown. Their protein has a good balance of amino acids with a chemical score of 62% and net protein utilization of 54%. These characteristics give sesame the potential of being a source of protein supplementation in cereal based foods (Alobo, 2000). Beniseed oil has the highest concentration of Omega – 6-fatty acids and two naturally occurring preservatives, sesamol and sesamin. The seeds are also rich in manganese, copper and calcium (90mg per table spoon for unhulled seeds, 10mg per table spoon for hulled seeds) and contains vitamin B_1 (thiamine) and vitamin E (tocophenol) (Sosanya, 2007).

Therefore, supplementing with other legumes and oilseeds like beniseed high in protein and lysine could improve the nutritional quality of the diet of the consumer, and also promotes masa as a breakfast and snack item.

The work is aimed at producing high quality millet based *masa* using beniseed.

The objectives of the work include: Producing beniseed-millet composite *masa* of 0 – 50% beneseed substitution, evaluating the effect of the substituted beniseed flour on the chemical, and sensory and microbial quality of the produced *masa*.

MATERIALS AND METHODS

The pearl millet (*Pennisetum glaucum*), beniseed (*Sesamum indicum*), baker's yeast (*Sacharomyces cerevisiae*), *kanwa* or trona (Sodium bicarbonate) were purchased at Wunti Market, Bauchi State. The pearl millet (*Penisetum glancum*) was cleaned, and dehulled using dehulling machine. After which it was soaked for 12 hours and then drained of water and dried before grounding into flour which is sieved to give grits and fine flour. The grits are cooked and allowed to cool and then added to the flour together with water. The resulting batter is inoculated with beaker's yeast and allowed to ferment for 14-16hours. The batter is then diluted with trona (Kanwa water) and then sugar and salt are added. With the aid of pestle and mortar, the batter is stirred vigorously to incorporate air. The batter is taken in medium seized spoon and placed in a pan with individual cup-like depression containing little oil and then fried. The batter is fried for 3-5 minutes with other side of the masa turned in between frying. After preparation, the masa sample is analyzed for protein content, fat content, moisture content, ash content. Also the dimension of masa i.e. diameter, thickness and loaf volume were also evaluated (see table 1 and Figure 1)

The respective loaf volume was assessed by seed displacement method. The spread ratio is calculated as diameter/height (Ayo et al, 2003).

Sensory Quality

The sensory evaluation of the samples was carried out for consumer acceptance and preference using 15 untrained judges (students and staff of the Department of Food Science and Technology, Federal Polytechnic, Bauchi), randomly selected using a nine(9)-point Hedonic scale (one and nine representing "extremely dislike" and "extremely like", respectively. The mean scores were differentiated using analysis of variance methods. The qualities assessed include colour, taste, odour, texture, appearance and general acceptance coded samples of the same size and temperature (29oC) were served on a coloured (white) plate of the same size to judges in each panel cupboard under the fluorescent light. Only one sensory attribute was tasted at one sitting.

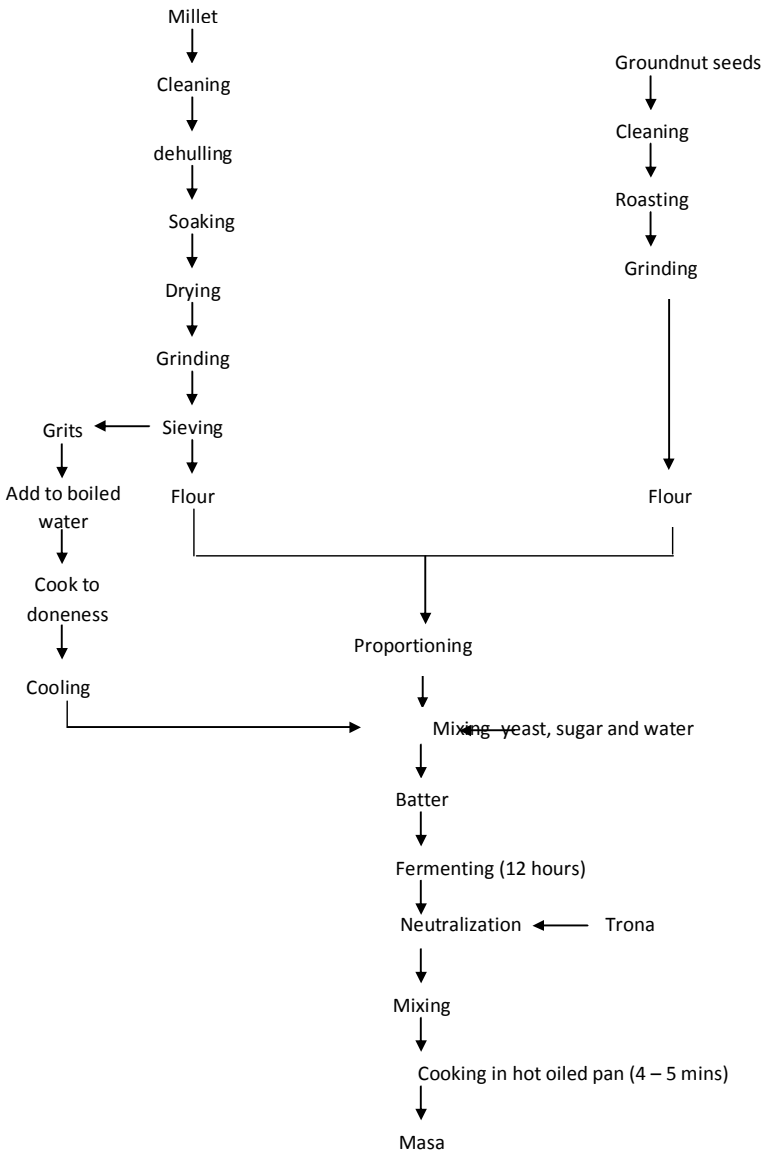

Figure 1. Flow chart for the production of Composite Masa

Microbial Analysis

Total plate count and fungi growth were determined. Pour plate technique was adopted using peptone water, potato dextrose and nutrient agar using the method of Jideani and Jideani(2006)

Chemical Quality

The proximate composition of the products (protein, fats, ash, carbohydrate and moisture content) were determined (AOAC, 1995).

RESULTS AND DISCUSSION

Effect of Added Beniseed Flour on the Chemical Quality of Millet Based Masa

Results of the effects of added beniseed flour on the chemical qualities of masa made from millet grain is summarized in Table 2.

There was appreciable increase in protein (8.88 – 11.20%). The protein content increased to 14.3% at the acceptable level of 20% added beniseed flours (Table 2). This could be due to the added beneseed flour which is high in protein content. Dupriez and Leenar (1988)

Table 2. Effect of Added Beniseed flour on the Chemical Quality of Milet added Masa

MILLET (%)	BENESEED (%)	PROTEIN (%)	FAT (%)	CARBOHYDRATE (%)	MOISTURE (%)	ASH (%)	ENERGY (Cal/g)
100	0	8.88	9.40	75.32	3.8	2.6	421.4
90	10	9.63	10.02	75.35	2.8	2.2	430.1
80	20	10.15	10.40	75.25	2.4	1.8	435.2
70	30	10.54	10.79	74.87	2.2	1.6	438.75
60	40	10.89	11.17	74.54	2.0	1.4	444.25
50	50	11.20	11.56	74.44	1.8	1.0	446.6

Table 3. Effect of added beneseed four on the physical quality of masa from millet grain

SAMPLE MILLET (%)	BENESEED (%)	WEIGHT (g)	Loaf Volume	Loaf volume Index (cm^3/g)
100	0	68.5	85	1.24
90	10	69.0	105	1.52
80	20	69.4	135	1.95
70	30	69.9	155	2.22
60	40	70.3	185	2.63
50	50	70.8	215	3.04

observed that beniseed whole seed contains 22% protein. Other research works has shown that addition of legumes seed paste/flour to carbohydrate based foods increased the protein content of the food. Effect of groundnut paste on the quality of maize based *masa* (Ayo et al, 2008) showed a maximum increase of 21.23% at the acceptable level the added groundnut paste. The addition of cowpea and groundnut to rice, millet has been found to improve the protein content of the product (Nkama and Malleshi, 1998)

There was an increase in fat of about 10.64% as shown on Table 2. The incould be due to the added beniseed which agreed with Iwe (2000) that beniseed has high oil content of about 43% (white seed) and 91% (meal).

(Dupriez and Leener,1988). The increase in fat content could be due to the added beneseed flour. Research work carried out by Ayo et al (2008) on the Effect of groundnut paste on the quality of maize based masa showed an increase of about 12.13% in the fat content. This shows that addition of legumes seed paste or flour increases the oil intent of the food it's being added to especially those legumes high in oil content.

Moisture

There was decrease in moisture content as shown in table 4.32, from 3.8 to 1.8 on addition to beneseed flour (0 – 50%). It decreased by 36.84% at the acceptable unit of 11% added beneseed. This decrease in moisture content is as a result of the added beneseed flour. This means that in adding beneseed the moisture in the food reduced which shows that the shelf life of the food will be much longer than when it was only the millet grain that was used. The research work on effect of groundnut paste on the qualities of maize based *masa* (Ayo et al, 2008) also showed decrease in the moisture content from 14.24 to 5.54% on addition of groundnut paste. Though groundnut is not the same as beneseed, both are legumes and beans to have the same effect on the moisture content of carbohydrate based foods.

Ash

The ash content decreased from 2.6 to 1.0% (Table 4.23) and by 30.76% decreases (Table 4.22). This decrease in ash content is due to the added beneseed flour. Research work done by Ayo et al (2008) on effect of groundnut paste on the qualities of maize based masa showed a decrease in ash content from 2.1 to 0.8%. Decrease in ash content could affect the mineral content of the food.

Carbohydrate

There was decrease in carbohydrate content from 75.32 – 74.44% with an increase in energy from 421.4 – 446.6cal/g as shown in table 4.23. This is due to the added beneseed flour (0.50%). As beneseed is added the carbohydrate content decreased while fat and protein increased.

Effect of added beneseed flour on the physical quality of masa made from millet grain

The effect of added beneseed flour on the physical quality of masa made from millet grain is summarized on Table 3.

Table 4. Effect of added beneseed on sensory quality of masa made from millet grain

MILLET (%)	BENESEED (%)	COLOUR	TASTE	TEXTURE	AROMA	APPEARANCE	GENERAL ACCEPTABILITY
100	0	5.10ab	5.55ab	6.45a	5.70	5.05ab	6.05ab
90	10	5.15ab	6.40ab	6.15ab	5.90ab	5.10ab	5.95ab
80	20	6.85a	7.25ab	5.75ab	7.10a	6.05a	7.15a
70	30	5.0ab	5.10ab	5.30ab	5.40ab	5.30ab	5.70ab
60	40	4.65b	4.9b	5.30ab	5.25b	5.25ab	5.15b
50	50	4.45b	5.0b	4.65b	4.95b	4.15b	5.0b

*Scores with the same subscript are not significantly different at p=0.05.

Loaf volume and loaf volume index

The loaf volume and loaf volume index increased from 8.5cm^3 – 215cm^3 and 1.24cm^3/g – 3.04cm^3/g respectively. The increase in volume could be due to the trona water added which is believed to assist in learning or swelling (Springiness) of the product (Nkama and Malleshi, 1998).

Effect of added beneseed flour on the sensory quality of masa produced from millet grain

The effect of added beneseed flour in the sensory quality of millet based masa as summarized in Table 4.

Texture

The average mean scores for textures decreased from 6.45 to 4.65 with increase in percentage (0 – 50%) added beneseed flours as shown in table 4.20. There was a significant difference in the average mean scores at 20% added beneseed flour. The marked difference in the texture of this level (20%) and above could be due to the increased oil content from the added beneseed.

Colour

The average mean serves for colour are 5.10, 5.15, 6.85, 5.0, 4.65 and 4.45 as shown on table 4.20. It decreased from 5.10 to 4.45 with increase in percentage (0-50%) added beneseed flour. There was significant difference at 20% level of added beneseed, which shows that at this level (20%) and above the product was accepted but the highest level of acceptance was at 20%. This could be because of the white specie of beneseed used and could also be that there was a balance between the two raw materials (millet and beneseed) used so that the product was not too dark or too white.

Aroma

The average mean score for aroma decreased from 5.10 to 4.15 with increase in percentage (0-50%) added beneseed flour. There was significant difference at 20% level and above of added beneseed flour. This could be due to beneseed flavour which at this level is moderate.

Appearance

The average mean scores are 5.05, 5.10, 6.05, 5.30, 5.25 and 4.15 respectively. There was decrease from 5.05 to 4.15 with a marked significant difference at 20% and bore, at the addition of beneseed flour, which enhances the appearance of the product.

Taste

The average mean serves for taste decreased from 5.55 to 5.0 with increase in percentage (0-50%) added beneseed flour. There was significant difference at 20% and above addition of beneseed. This could be due to the beneseed added. The highest level of acceptance was at 20% which shows that at this level a balance was reached between the two materials (beneseed and millet) so that it was not too better as beneseed has an after bitter taste.

General acceptability

The average mean scores of the general acceptability are 6.05, 5.95, 7.15, 5.70, 5.15 and 5.0. There was a decreased from 6.05 to 5.0 with increase percentage (0 – 50%) added beneseed flour. There was significant

Table 5. Effect of added beniseed flour on the microbial quality of masa produced from millet

SAMPLE		BACTERIA COUNT (cfu/ml)	CULTURAL CHARACTERISTICS	MORPHOLOGICAL CHARACTERISTICS	GRAM REACTIO	MORTALI TY TEST	SUGAR FERMENTATION					CATALYS T	COAGULA SE	PROBABLE ORGANISM
MILLET (%)	BENESEED (%)						GLU COS	FRU CTO	GAL ACT	LAC TOS	MAL ET			
100	0	5.0×10^5	Creamy raised with irregular spread	Short rods in pairs	tre	tre	GA	GA	-re	-re	A	tre	tre	Bacillus spp
			Creamy white round colonies	Short rod in chains	tre	tre	GA	GA	GA	GA	GA	-re	tre	Steptobacillus spp
90	10	3.0×10^5	Creamy white round colonies	Short rods in chains	tre	tre	GA	GA	GA	GA	GA	-re	tre	Steptobacillus spp
			Creamy white spread colonies	Cocci in chains	tre	tre	GA	-re	-re	-re	A	tre	-re	Steptobacillus spp
80	20	3.0×10^5	Creamy spread branching colonies	Cocci in clusters	tre	tre	GA	-re	-re	-re	A	tre	-re	Steptobacillus spp
			Orange and mind colonies	Cocci in chains	tre	tre	GA	GA	A	-re	A	-re	tre	Steptobacillus spp
70	30	1.0×10^5	Creamy yellow round colonies	Cocci in chains	tre	tre	GA	GA	A	-re	A	-re	tre	Steptobacillus spp
60	40	2.0×10^5	Creamy white spread colonies	Cocci in clusters	tre	tre	GA	-re	-re	-re	A	tre	-re	Steptobacillus spp
50	50	1.0×10^5	White feather-like branching colonies	Short rods in the clusters	tre	tre	GA	-re	-re	-re	A	tre	-re	Bacillus spp
			Creamy white spread colonies	Cocci in clusters	tre	tre	GA	-re	-re	-re	A	tre	-re	Steptobacillus spp

KEY: tre= positive, -re = Negative, GA – Gas and Acid, A = Acid

difference at 20% level. From the results in table 4.20, it shows that all the samples were accepted but the highest level of acceptance is at 20% level.

Effect of added beneseed flour on the micro-biological quality of masa produced from millet grain

From the result obtained as shown in Tables 5 and 6, shows a higher microbial load at 0% concentration, 6.0×10^6 and 5.0×10^5 total fungal count and total bacteria count, respectively. However, with increasing concentration of beneseed, microbial load generally reduced.

This could be that beneseed could be contained bactericidal properties which reduces the microbial population as it was being added in increasing properties. Beneseed contains powerful antioxidants called ligneous which are anticencinogenic and phytosterols which block cholesterol productors in humans; it also contains phytic acid (Wikipedia, 2008). It could be that some of these properties might be antimicrobial. Beneseed has high oil content and the oil contains mainly unsaturated fatty acid celeic and linoleic acid, about 14% each) and 14% saturated acid. It could still be that the oil could reduce microbial growth as it can act as a layer preventing the penetration of oxygen which some micro-organisms need to survive. The amount of oxygen in the environment is a crucial for survival/growth factor for micro-organisms. Moulds are aerobes requiring oxidized conditions, thus oxygen to be present. Some bacteria, notably the ones that cause food spoilage are strict aerobes (Murano, 2003).

Table 6. Fungal count

SAMPLE MILLET (%)	SAMPLE BENESEED (%)	FUNGAL COUNT (cfu/ml)	CULTURAL CHARACTERISTICS	MORPHOLOGICAL CHARACTERISTICS	PROBABLE ORGANISM
100	0	6.0×10^6	Creamy white colonies	Large budding cells	Saccheronyes spp
			Fluty white background and green centre	Long branched cunidiophore with septed lyhere	Penicillin spp
90	10	3.0×10^5	Creamy white mind colonies	Large buddy cells	Saccharonyces spp
80	20	1.5×10^6	Flutty white background and green centre	Large branched conidiphere with septed lyhere	Penicillin sp
			Creamy white round colonies	Large budding cells	
			Fluty white, brown centre	Radiate of cinidia head with smooth wall	Saccharonyces spp Aspergillus spp
70	30	5.0×10^5	Fluty white brown centre	Radiate of cinidia head with smooth wall	Aspergillus spp
60	40	3.0×10^5	Creamy white round colonies	Large budding cells	Saccharonyies spp
50	50	1.0×10^5	Fluty white, brown centre	Radiate of cinida head with smooth wall	Aspergillus spp
			Creamy white round colonies	Large budding cells	Saccharonyces spp

CONCLUSION

The sensory evaluation results obtained showed that masa made from millet grains and fortified with beneseed flour was accepted up to separate 20% level of added beniseed flour in respect to sensory parameters and corresponding to of 14.3, 10.64 and 30.76% increase in protein, fats and ash content of the product.. This is an indication of improved nutritional intake of the consumers and at a cheaper cost, considering that legumes used are readily available. There was also an increase in fat content by 10.63% which could increase the energy intake of the consumers; however, the food can easily spoil as are sult of by rancidity. The use of high quality vegetable oil can reduce the occurrence of rancidity. Also beneseed oil contains high percentage of ligneous which create excellent resistance to oxidative deterioration. There was decrease in moisture and ash content. This decrease in moisture content could be an advantage in the extension of the shelf life of the food.

The work has therefore showed that the quality of milt based masa can be improved by addition of benseed. The introduction of such a nutritionally improved product in Nigeria could play an important role in improving diets especially in the northern part of the country where this product (masa) is greatly consumed.

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