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Full Length Research Paper

Functional properties and quality evaluation of "kokoro" blended with beniseed cake *Sesame indicum*

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A research work was carried out to evaluate the functional properties and quality of "Kokoro" blended with defatted Beniseed cake. Maize flour and Beniseed cake were mixed thoroughly in various proportions; AZO- (100%Maize), MBK-(90:10), EJT-(80:20), SIL-(70:30) and LMA-(60:40) Maize: Beniseed seed cake, respectively. The blends were each made into a thick paste, manually shaped into a noodle shape of about 3 mm diameter and deep fried in hot vegetable oil (170°C) for 5 min. Chemical, functional and pasting properties of the blended flour were evaluated. The result showed that the crude protein increased with increase in the proportion of the Defatted Beniseed flour (DBF) in the "Kokoro" samples AZO 5.32 ± 0.08[e] to LMA 13.42 ±0.11[a]. Results revealed that a significant difference (*P<0.05*) in all the functional properties where sample AZO (100% maize) had the highest value of 0.51g/ml and 0.68 g/ml for bulk and loose density, respectively. The water absorption capacity followed a similar trend like oil absorption capacity. The pasting characteristics of the Maize-Beniseed blend gave a peak viscosity ranging from 1.42 RVU to 27.55 RVU, where sample LMA (60:40) had the highest value. The study revealed that the increase in Beniseed cake caused general decrease in gelling stability. The sensory results indicated that increase in Beniseed cake cause decreased in the score attributes in terms of taste, colour and crispiness of the "Kokoro" -Beniseed blend. The products were subjected to sensory evaluation by adopting preference-ranking test and analyzing the data using ANOVA. No significant difference (*P ≤0.05*) was found among the samples for overall acceptability. Data collected from all experiments were in triplicate, and subjected to statistical analysis, using analysis of variance (ANOVA). Differences between the treatment means were separated using Duncan's multiple range tests.

Key words: Kokoro, beniseed cake, *sesame indicum*, functional properties.

INTRODUCTION

Indigenous snacks could be a way of entertaining guests but the time for eating snacks between meals may be different and also the type of food consumed may also vary from one part of the country to another (Maliki, 1999). In developing countries like Nigeria that is seriously experiencing rapid process of rural urban migration and industrialization. Among many types of food source, snacks that are relied upon to meet the physiological need of the people is *"Kokoro"* common in the western part of the country. Most Nigerian children especially in the urban areas receive snacks items such as biscuits, meat pies, chin -chin, dough nuts, and potato chips, while children in the rural areas make do with fried melon seed cake, *robo*, and fried maize paste, *"Kokoro"* with a very low nutritional value (Lasekan et al., 1996). *"Kokoro"* is traditionally produced from thick coarse corn paste for adult and children (Kent and Ever, 1994). People that consume "*Kokoro*" in large quantity are faced basically with a large intake of carbohydrate, the low

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Abbreviation: DBF, Defatted beniseed flour.

protein content in “*Kokoro*” is very evident, with a shortage of tryptophan and lysine together with its low niacin content may contribute further towards the incidence of pellagra in maize-consuming areas (Oyetoro et al., 2007; Lasekan and Akinola, 2002). Low protein intake has been majorly attributed to the increase in high cost of traditional sources of animal protein Osho (2003). Friedman (1996), highlighted the essentiality of protein component in the diet, needed for human survival. Its basic function in nutrition is to supply adequate amount of needed amino acids but availability of amino acid varies with protein sources, processing treatment and interaction of other components of the diet. It is a well-established fact that most leguminous plant seeds are rich in nutrients such as digestible protein with a good array of amino acids and minerals (Fagbemi et al., 2004; Agbede and Aletor, 2003). Complementary request for utilization of these legumes is encouraged by the fact that it is regarded as the cheapest source of proteins especially in the diets of resource-poor classes of the population in West Africa (Altschul and Wilcks, 1985; Oshodi and Aletor, 1993; Fagbemi et al., 2006).

Although there is the lack of adequate information on the composition and processing effects on the food value (Aletor and Aladetimi, 1989; Adeyeye, 1995; Agbede and Aletor, 2003). Beniseed is an oilseed rich in protein, and methionine hence it has potential use in food products as a protein supplement, and there is a need to utilize the defatted sesame meal for edible purposes. The chemical composition of sesame shows that the seed is an important source of oil (44 to 58%), protein (18 to 25%), carbohydrate (13.5%) and ash (5%) (USDA, 2009). Nigeria however, was ranked as the 5th largest producer of the commodity in the world in 2008, with an estimated production of 120,000 metric tons annually (FAOSTAT, 2010). The seeds are generally processed for its oil, but the utilization of its cake though high in protein percentage and rich in methionine (3.2%), which is often the limiting amino acid in legume-based tropical diets is still under exploited.

The food habits of Nigerians are rapidly changing from the traditional foods to lighter foods such as snacks. Producing snack using Maize and Beniseed will further add variety to the existing list of snack food as well as improve the under utilization of Beniseed which can substitute other plant protein sources (Adebowale et al., 2007). Snacks consumption is on the increase nationwide for so many reasons: increase in one-person, households, working mothers and rural urban migration. The high nutrition requirement in children of primary school; therefore suggest that the nutritional content of snacks should be increased. Therefore, if snacks can be enriched with high protein flour, it will help to increase the amount of protein intake by children and other snacks consumed and can even serve as daily substitute for food among children, (Akinlua et al., 2007; Lasekan et al., 1996). This work is aimed at evaluating the functional properties and quality of “*Kokoro*” enriched with Beniseed cake so as to improve the quality of “*Kokoro*” snack which is seriously gaining acceptance in western part of Nigeria.

MATERIALS AND METHODS

Dry Corn (White Variety), Beniseed, vegetable oil, onion and salt were purchased from Mile 12 Market, Kosofe local government area in Lagos. The Seeds were cleaned, to remove contamination with any foreign material and subsequently steamed in order to ease the problem of dehulling. The separation of hull from seed was achieved by using brine (15% salt solution) and floatation technique, (6 litres of 15% salt solution per kilogram of raw seeds) in a container, rubbing and rinsing with fresh water to eliminate the hulls. The wet seeds resulting from the dehulling process were drained, dried and roasted in an open pan to a temperature of about 95℃ till the wet weight is reduced to 25%. Th e seeds were milled using a plate mill to an oily paste for oil extraction. Hydraulic press was used to further reduce the quantity of oil left in the pressed cake to about 4.68%. The oil obtained was then filtered and bottled, while the cake was dried in an open pan at a temperature of about 95°C. The dried cake is milled into powder according to the method of Oresanya and Koleosho (1990). The dry maize grains were winnowed to remove dust, dirt and foreign matter, after which it was subjected to wet cleaning to remove lightweight and damaged grains by floatation method.

The cleaned grains were then partially cooked for 50 min to gelatinize the starch. The grains were then washed with fresh cold water after draining then milled to form a thick coarse paste. During the milling, water was not added as this would result in a watering paste which might be difficult to handle when it comes to molding and folding the strips Oloyo (1999). Blends of coarse corn paste substituted with Beniseed cake were prepared ranging from substitution from10, 20, 30 and 40%. Equal amount of onion and salt were added to each of the blends as taste and flavor additives and then mixed thoroughly to a smooth texture and even distribution. The control was made from maize alone. The procedures and formulation used were as that used for commercial production of”Kokoro” (Maliki, 1999). About 300 g of each blend (Maize and Beniseed cake) were mixed thoroughly in various proportions; 100:0, 90:10, 80:20, 70:30 and 60:40 Maize: Beniseed, respectively. The blends were each made into a thick paste and then manually rolled into noodle shape of about 3 mm diameter and deep fried in hot vegetable oil at 170°C for 5 min. The fried maize based snacks were left to cool, drained and then packaged in polythene. The flame intensity was constant throughout for all the samples (Olapade et al., 2002).

Chemical composition

The method of AOAC (1990) was used to determine the moisture, protein, ash, fat and crude fibre content, while carbohydrate was obtained by difference method. The Peroxide value, saponification and acid values were determined according to the AOAC (1990).The Calorie energy determination was carried out according to method described by Owoso et al. (2000).

Functional properties determination

Water absorption capacity was determined by the method described by Sathe et al. (1981); Eke and Akobundu (1998). The foaming capacity and stability of the samples were determined using method described by Kinsella (1976).The procedure by Okezie and Bello (1988) was used to determine the emulsion

Table 1. Proximate composition of "Kokoro" (maize-beniseed blend).

Samples	AZO	MBK	EJT	SIL	LMA
Ash content (%)	2.36 ± 0.01[d]	2.46 ± 0.03[c]	2.48 ± 0.02[c]	2.54 ± 0.02[b]	2.60 ± 0.01[a]
Carbohydrate (%)	68.88±0.09[e]	67.52±0.05[d]	66.78±0.00[c]	63.03±0.11[b]	61.98±0.12[a]
Fat (%)	14.70±0.04[e]	15.01±0.04[d]	15.00±0.04[c]	15.73±0.05[b]	15.85±0.03[a]
Protein (%)	5.32 ± 0.08[e]	6.74 ± 0.06[d]	9.32 ± 0.08[c]	11.30±0.08[b]	13.42±0.11[a]
Crude fiber (%)	1.45 ± 0.03[a]	1.39 ± 0.03[a]	1.27 ± 0.04[b]	1.20 ± 0.02[b]	1.09 ± 0.03[c]
Calorific energy (kcal/100 g)	4.00 ± 0.02[c]	4.11 ± 0.00[b]	4.00 ± 0.00[c]	4.12 ± 0.00[a]	4.13 ± 0.00[a]
Moisture (%)	7.29 ± 0.04[a]	6.88 ± 0.02[b]	5.15 ± 0.02[d]	6.20 ± 0.02[c]	5.06 ± 0.03[e]
Peroxide value (%)	6.27 ± 0.04[a]	5.91 ± 0.05[b]	4.42 ± 0.04[d]	5.97 ± 0.02[b]	4.75 ± 0.04[c]
Acid value (%)	1.17 ± 0.02[d]	1.26 ± 0.02b[c]	1.21 ± 0.04[cd]	1.30 ± 0.14[ab]	1.33 ± 0.02[a]

Values are means of two replicates. Means in the same row with different superscripts are significantly different (*p<0.05*).Carbohydrate was calculated by difference. Maize: Beniseed Ratio- AZO-(100%Maize), MBK-(90:10), EJT-(80:20), SIL-(70:30), LMA-(60:40).

capacity. Emulsion stability was determined by the method described by Mempha et al. (2007). This was determined according to the method described by Sathe et al. (1981) and Dispersibility was determined according to method described by Okaka and Potter (1979).

Pasting properties test determination

The pasting property of the sample was determined according to the Newport (1998) procedure based on 100% dry matter. The sample was mixed with 25 ml distilled water and placed into the canister; the paddle was placed into the canister which will in turn insert into the instrument. The measurement cycle was initiated by depressing the motor tower of the instrument. On loading the RVA machine, it was set at 40℃ and allowed to run for 2 0 min. The canister was removed on the completion of test.

Sensory evaluation

Quality attributes of the "Kokoro" made from 100% corn paste and corn paste substituted with 10, 20, 30 and 40% Beniseed cake, respectively were assessed by a sensory panelist. The panelists were supplied with a form and asked to score the sample using 9 point Hedonic scale with respect to taste, colour, crispiness, flavor and overall acceptability. All the results were subjected to statistical analysis using SPSS 15. The scores were ranked and analyses of variance (ANOVA) were computed. Where significant differences between the treatment means were separated using Duncan's multiple range tests.

RESULTS AND DISCUSSION

Proximate properties

The results of the proximate analysis are shown in Table 1. This showed that the crude protein increased with increase in the proportion of the DBF level in the "Kokoro" samples. The results indicated that there was a significant difference ($p<0.05$) in the entire sample for all the proximate parameter. Sample LMA (60:40) had the highest protein content of 13.42% while Sample AZO (that is, 100% Maize) had the least crude protein of 5.32%, this is however obviously due to increase in the proportion of the DBF added. Crude fibre is known to aid the digestive system of human. LMA (60:40) had the least value of crude fibre 1.09% and AZO (100%maize) had the highest crude fibre content and there was decrease in crude fibre obtained with increase in the proportion of DBF. The fat content of the sample ranged between (14.70 to 15.85%). The fat content results were similar to the fat content obtained by Oloyo (1999) in whole maize "Kokoro". The value obtained for the ash content also indicated that LMA (60:40) had the highest value of 2.60% while AZO (100% maize) had the least value ash content of 2.36%. This indicates that incorporation of Beniseed may enhance the mineral intake of the amount of minerals in food products (Oyetoro et al., 2007).

The result indicated that Sample AZO (100% maize) had the highest value of 7.29% while Sample LMA (60:40) had the least moisture content of 5.06%. These values were relatively minima and may not have adverse effect on the quality attributes of the products (Oyetoro et al., 2007). The results also showed that there was a significant difference ($p<0.05$) between all the samples in the carbohydrate content, where sample LMA (60:40) had the highest value of 38.02% and Sample AZO (100% Maize) had the least value of 31.11%. Though, there was increase in carbohydrate with increase in DBF proportion which may be as a result of Beniseed flour which had carbohydrate content between (9.1 to 25.3%) depending on the type of Beniseed used, (USDA, 2003). The calorific values showed that there was a significant difference ($p<0.05$) between the samples where sample LMA (60:40) had the highest value of 413 kcal/100 g while sample AZO (100% maize) and EJT (80:20) had the least values of 400 kcal/100 g, respectively. The Acid value is a measure of the amount of free fatty acid present in a fat/oil or its products, some of the

Table 2. Functional properties of "kokoro" (maize-beniseed blend).

Samples	AZO	MBK	EJT	SIL	LMA
Loose bulk density (g/ml)	0.51 ± 0.00[a]	0.50 ± 0.00[b]	0.48 ± 0.00[c]	0.45 ± 0.00[d]	0.43 ± 0.00[e]
Packed bulk density (g/ml)	0.68 ± 0.00[a]	0.65 ± 0.00[b]	0.58 ± 0.00[c]	0.57 ± 0.00[d]	0.55 ± 0.00[e]
Oil absorption capacity (g/mg)	2.17 ± 0.01[a]	1.96 ± 0.01[b]	1.87 ± 0.02[c]	1.94 ± 0.02[d]	1.85 ± 0.03[c]
Water absorption capacity (g/100 g)	166.00 ± 1.41[a]	160.00 ± 1.41[b]	154.00 ± 1.41[c]	148.00 ± 1.41[d]	144.00 ± 1.41[e]
Swelling capacity (%)	4.63 ± 0.01[a]	4.44 ± 0.01[b]	4.33 ± 0.03[c]	4.31 ± 0.03[c]	4.17 ± 0.01[d]
Emulsion capacity (%)	48.36 ± 0.21[a]	46.20 ± 0.14[b]	43.65 ± 0.21[c]	41.50 ± 0.14[d]	40.35 ± 0.21[e]
Foaming capacity (%)	7.40 ± 0.28[a]	6.40 ± 0.14[b]	5.70 ± 0.14[c]	5.20 ± 0.14[c]	4.50 ± 0.28[d]
Foaming stability (%)	1.81 ± 0.02[a]	1.67 ± 0.02[b]	1.57 ± 0.03[c]	1.51 ± 0.02[d]	1.45 ± 0.03[d]
Dispersibility (%)	72.00 ± 1.41[a]	67.00 ± 1.41[b]	62.00 ± 1.41[c]	57.00 ± 1.41[d]	53.00 ± 2.83[d]

Values are means of two replicates. Means in the same row with different superscripts are significantly different ($p<0.05$). Maize: Beniseed Ratio- AZO-(100%Maize), MBK-(90:10), EJT-(80:20), SIL-(70:30), LMA-(60:40).

deterioration that takes place during storage of either the raw material from which the fat/oil is obtained or the fat/oil itself after isolation result in hydrolysis of triglycerides to yield free fatty acids. It is also used to indicate quality and shelf life of the fat/oil products. The result indicated that the sample with least Acid value would deteriorate faster thereby having bad quality and low shelf stability, which may equally affect the taste of the product (Maliki, 1999: Connor, 2000).

Functional properties

The results obtained are shown in the Table 2, revealed that there were significant difference ($P<0.05$) in all the functional properties where sample AZO (100% maize) had the highest value of 0.51 and 0.68 g/ml, respectively, while sample LMA (60:40) had the least value of 0.43 and 0.55 g/ml, respectively. The result of both the loose and packed bulk density revealed a decreased with increase in the level of DBF. It also showed that the bulk density (loose and packed are low and can occupy more space if packed in a container). This may also be used to determine packaging requirement, material handling equipment and application of the type of food in the food industry, (Mempha et al., 2007). The water absorption capacity increased with increase in Beniseed inclusion in the corn flour. 166.00 ±1.41 (AZO), 160.00±1.41(MBK), 154.00 ±1.41(EJT), 148.00 ± 1.41(SIL) and 144.00 ± 1.41(LMA) this decreased with increase in the Beniseed inclusion a similar trend existed for oil absorption. The results obtained were in the range obtained by Tagode and Nip, (1994) Aletor and Oyelabi (2007). Water absorption behavior cannot be dissociated from the nature of starch of the Maize and Beniseed in the product. The nature of starch has been found to have effect on the water absorption capacity (Sathe and Salunkhhe, 1981; Finney, 1994; Shimelis et al., 2006).The result also showed that the samples might be useful in confectioneries products where hydration to improve handling is desired, where oil absorption property is of prime importance, (Mempha et al., 2007).

The swelling capacity is a function of the product to rise when having interaction with water. Finney (1994) reported that the swelling capacity affects the temperature at which a product forms gel in maize flour, a similar observation was made. The emulsion capacity ranged from 40.35 to 48.36% this showed that there was significant difference ($P<0.05$) between all the entire samples in the emulsion capacity. Sample AZO (100% maize) had the highest value of 48.36% which is an indication that the sample has the capacity or tendency to form emulsion more than other samples with increased in Beniseed proportion which may be due to the presence of amylose and amylopetin content in the maize flour (Mempha et al., 2007). According to Pomeranz (1991) the value of solubility and swelling power of starch may be due to the protein-amylose complex formation in isolated starches and may cause decrease in swelling power. The result of the foaming capacity showed that there was no significant difference ($P<0.05$) between sample EJT (80:20) and SIL (70:30) while there was a significant difference ($P<0.05$) between other samples. The foaming capacity value ranged from 4.50 to 7.40%. The foamability (foam capacity and stability) is related to the rate of decrease of the surface tension of air-water interface caused by absorption of protein molecules (Eke and Akobundu, 1993; Mempha et al., 2007). The percentage dispersibility showed that there was a significant difference ($P<0.05$) between all the samples except sample SIL (70:30) and LMA (60:40), sample AZO (100% maize) had the highest value of 72% while sample LMA (60:40) had the least value of 53%. This shows that sample AZO (100% maize) has the ability to disperse more and faster in an aqueous solution or during food processing than other sample, this may be due to the level of defatted Beniseed proportion into the products, (Mempha et al., 2007). The functional properties revealed that the flour blended of corn flour and Beniseed may find application in some other snack formulation where oil is

Table 3. Pasting properties of “kokoro” (maize-beniseed blend).

Samples	AZO	MBK	EJT	SIL	LMA
Peak viscosity (RVU)	10.08 ± 4.95^{cb}	15.84 ± 3.42^{b}	6.38 ± 0.18^{cd}	1.42 ± 0.23^{d}	27.55 ± 1.24^{a}
Trough (RVU)	7.96 ± 4.30^{bc}	13.71 ± 3.01^{b}	4.71 ± 0.53^{cd}	0.34 ± 0.47^{d}	26.42 ± 0.47^{a}
Breakdown (RVU)	2.13 ± 0.64^{a}	2.13 ± 0.42^{a}	1.67 ± 0.35^{b}	1.50 ± 0.71^{c}	1.13 ± 0.77^{d}
Final viscosity (RVU)	21.84 ± 6.24^{c}	36.24 ± 6.07^{b}	15.92 ± 0.17^{c}	4.05 ± 1.04^{d}	50.17 ± 1.06^{a}
Setback (RVU)	13.88 ± 1.94^{b}	22.50 ± 3.07^{a}	11.21 ± 0.18^{b}	4.13 ± 1.50^{c}	23.75 ± 0.60^{a}
Peak time (minutes)	7.00 ± 0.00^{a}	6.97 ± 0.05^{b}	6.87 ± 0.19^{c}	6.50 ± 0.42^{d}	6.94 ± 0.09^{b}
Pasting temperature (℃)	94.33 ± 0.04^{e}	94.73 ± 0.04^{b}	95.08 ± 0.04^{a}	94.63 ± 0.04^{c}	94.84 ± 0.04^{d}

Values are means of two replicates. Means in the same row with different superscripts are significantly different (*p<0.05*). Maize: Beniseed Ratio -AZO-(100%Maize), MBK-(90:10), EJT-(80:20), SIL-(70:30), LMA-(60:40).

not relevant (Oshodi et al., 1997; Aletor and Oyelabi, 2007).

Pasting properties

The result in Table 3 showed the pasting characteristics of the maize-Beniseed blend. The value obtained gave a peak viscosity ranging from 1.42 RVU to 27.55 RVU, where sample LMA (60:40) had the highest value while sample EJT (80:20) had the least value of 1.42 RVU. The peak viscosity indicates the water binding capacity of the Maize-Beniseed blend. This may be correlated with the final product quality and also to ascertain the viscous load likely to be encountered by a mixer, (Dawson et al., 2006). The result showed that there was a significant difference (*p<0.05*) in all the entire samples. This result with low peak viscosity indicated relative less resistance to swelling and rupture to shear at high temperature and while decrease in the viscosity. This is an indicator of breakdown in viscosity. This is a period accompanied during the hold period of the test, where the sample is subjected to a period of constant high temperature (usually 95℃) and mechanical shear stress. This la ter disrupts the granules and amylose molecules will generally leach out into solution, which undergo alignment in the direction of shear, (Newport, 1998). The values of the trough shows that there was a significant different (*p<0.05*) in all the samples.

The breakdown also indicated that there was a significant difference (*P<0.05*) in all the samples except sample AZO (100% maize) and MBK (90:10), respectively. However these values were very low compared with values recorded for starch based produce and products (Zaidu et al., 2007; Amritpal et al., 2007). The breakdown being the difference between the peak viscosity and trough is an indication of the rate of gelling stability, which is dependent on the nature of the product, (Newport, 1998). The study revealed that increase in Beniseed caused decreased in gelling stability. The breakdown value ranged from 1.13RVU to 2.13RVU, sample AZO (100% maize) and MBK (90:10) had the highest value, respectively. The pasting temperatures for the samples were 94.33 (AZO), 94.73 (MBK), 95.08 (EJT), SIL (94.63) and 94.84°C (LMA) and are quite higher than values obtainable in the literature for many single processed product: Potatoes (Zaidul et al., 2007; Amritpal et al., 2007). Liu et al. (2003) results did not agree with the result obtained in this research probably because he used the growing sweet potato cultivars or the difference in botanical sources. The pasting characteristics of this Maize flour-Beniseed blend may be due to the sizes and shapes of the starch granules, ionic charge on the starch, kind and degree of crystalinity within the granules, presence or absence of fat and protein, and perhaps, molecular size and degree of branching of the starch fractions (Shimelis et al., 2006; Braber et al., 1998).

Sensory evaluation

Differences in the colour and texture may be due to the proportion of the Beniseed added to the product, (Cormick, 2001). It is however, unexpected that the sensory score for Sample LMA (60:40) in terms of flavor was the highest 7.4. The score for flavor of sample MBK (90:10) was relatively low compared to sample AZO (100% maize) and LMA (60:40). However, Sample MBK (90:10) was the most preferred while sample LMA (60:40) is the least preferred sample as shown in Table 4. The results indicated that increase in Beniseed Flour cause decreased in the score attributes in terms of taste, colour and crispiness of the “Kokoro” -Beniseed blend, this is attributed to the fact that people that consume “Kokoro” are not used to the flavored taste of the blend as Beniseed in high proportion has imparted the characteristic nutty taste of Beniseed on the product. From the Table 4, score 9 is the most preferred while score 1 is the least preferred in sensory attribute of the products.

Conclusion

The crude protein increased with increase in the

Table 4. Sensory evaluation of "kokoro" (maize-beniseed blend).

Samples	AZO	MBK	EJT	SIL	LMA
Taste	7.60^{a}	7.07^{a}	6.07^{b}	5.53^{b}	5.07^{c}
Crispiness	7.73^{a}	7.00^{b}	5.60^{c}	4.80^{d}	4.60^{d}
Flavour	6.53^{ab}	5.53^{cd}	$6.13b^{c}$	5.20^{d}	7.40^{a}
Colour	7.87^{a}	7.40^{a}	6.30^{b}	5.93^{b}	4.73^{c}
Overall acceptability	7.20^{a}	7.40^{a}	6.13^{b}	5.87^{b}	5.47^{b}

Values are means of two replicates. Means in the same row with different superscripts are significantly different ($p<0.05$). Maize: Beniseed Ratio- AZO-(100%Maize), MBK-(90:10), EJT-(80:20), SIL- (70:30), LMA-(60:40).

proportion of the DBF level in the "Kokoro" samples and there was a significant difference ($p<0.05$) in the entire sample for all the proximate parameters.

The water absorption capacity increased with increase in beniseed inclusion in the corn flour. 166.00 ± 1.41(AZO), 160.00 ± 1.41(MBK), 154.00 ± 1.41(EJT), 148.00 ± 1.41(SIL) and 144.00 ± 1.41(LMA) this decreased with increase in the Beniseed inclusion a similar trend existed for oil absorption. Water absorption behavior cannot be dissociated from the nature of starch of the Maze and beniseed in the product. The result also showed that the samples might be useful in confectioneries products where hydration to improve handling is desired, where oil absorption property is of prime importance (Mempha et al., 2007). The functional properties revealed that the flour blended of Maize flour and Beniseed may find application in some other snack formulation where oil is not relevant.

The result in Table 3 showed the pasting characteristics of the Maize-Beniseed blend. The value obtained gave a peak viscosity ranging from 1.42 RVU to 27.55 RVU, where sample LMA (60:40) had the highest value while sample EJT (80:20) had the least value of 1.42 RVU. The pasting temperatures for the samples were 94.33 (AZO), 94.73 (MBK), 95.08 (EJT), SIL (94.63) and 94.84°C (LMA). The pasting characteristics of this Maize flour-Beniseed blend may be due to the sizes and shapes of the starch granules, ionic charge on the starch, kind and degree of crystalinity within the granules, presence or absence of fat and protein, and perhaps, molecular size and degree of branching of the starch fractions. The results indicated that increase in Beniseed Flour cause decreased in the score attributes in terms of taste, colour and crispiness of the "Kokoro" Beniseed blend.

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