Shelf Life Preservation of Groundnut Paste with Some Powdered Botanicals

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Abstract
Research on the effects of treatment of groundnut paste with the powdered leaf samples of three common edible vegetables was conducted in the Botany Laboratory of the Rivers State University, Port Harcourt, Nigeria. The plant leaf materials used were the leaf of scent leaf (Ocimum virides), garden egg leaf (Solanum melongena) and bitter leaf (Vernomia amygdalina). The leaf samples were aseptically treated and sundried for three days and crushed into powder. Groundnut paste was also prepared aseptically from fried and ground groundnuts. 10 grams of the ground nut paste was weighed and varying concentrations of the powdered leaf added to the pastes and labelled accordingly. The treated groundnut paste samples were allowed to store in the laboratory and their proximate compositions tested for a period of three months on a monthly basis to determine the effects of the applied leaf extracts. It was observed that moisture contents of the groundnut paste treated with the various leaf powder reduced irrespective of the concentrations used. Bitter leaf powder increased the ash content, lipid and protein content of the groundnut paste. Carbohydrate and the lipid values of samples treated with bitter leaf reduced. Powdered scent leaf increased Carbohydrate, lipid and protein but also increased the ash and fibre values at 2g and 4g concentrations. However, ash and fibre contents reduced at 6g, 8g and 10g. Garden egg leaf powder increased Carbohydrate, lipid, and protein contents of groundnut pastes but reduced moisture, fibre and ash. The reduction of moisture by all the leaf samples is commendable as too much moisture leads to faster deterioration of agricultural products. However, the general increase in the protein contents of the groundnut paste is a good attribute in terms of value addition to the product. In general, the addition of dried and powdered leafy vegetables to groundnut paste will enhance the quality of this cherished local delicacy.

Key words: *groundnut paste, scent leaf, garden egg leaf, bitter leaf, proximate composition.*

Introduction

Groundnut **(***Arachis hypogea L***)** is a legume and occupies an important position in the economy of many countries especially in developing nations of the world (Purseglove, 1997). It is believed to have originated from South America and have been domesticated in various regions of the world (Eke-Ejiofor *et al*., 2012). The major groundnut producing countries include India, China and United States of America. Groundnut was introduced into Nigeria in the 16th century and has been estimated to have been cultivated on up to 1.4 million hectares of land. The production of groundnut has been hampered following its contamination by fungi especially *Aspergillus flavus* which secretes aflatoxin and causes cancer in man. It has also been reported that the incidence of *Aspergillus flavus* is enhanced through broken shells during harvest, and kernel splitting during processing (Eke-Ejiofor *et al*., 2011). Early

researchers have reported the isolation of this fungus in Tokyo between 1986 - 1990 (Onuegbu, 2002). Ground nut is consumed in Nigeria in a variety of ways as boiled, fried, roasted and usually eaten in combination with other products like maize, tapioca, garden egg and cucumber. It can be processed into other forms as delicacies used during traditional ceremonies like marriages, chieftaincy coronation, etc. One of the products of groundnut is kulikuli (groundnut cake) a traditional recipe prepared after extracting oil from groundnut, fried and consumed as snake (Purohit and Rajyalakshmi, 2011). It is very rich in protein and used in feeding livestock and man. The groundnut cake is fried in oil and used as a delicious food supplement and snacks. Groundnut is a very rich agricultural product that is high in energy due to its high fat and protein contents (El-Zalaki et al., 1996). The carbohydrate content is relatively low being below 30% of the whole content of fiber. It is an industrial crop whose major utilization is the source of oil for making soup, stew, sauces, confectionaries, pudding and bakery products. Another local product from groundnut is "yaji" groundnut flour that has been mixed with ground ginger, roasted cereals, alligator pepper and added salt to taste. Dankwa is another local product from groundnut which has been added ground alligator pepper, roasted cereal, sugar, salt and pounded and molded to balls. These condiments are found among the Hausas. However, in the eastern and the southern parts of Nigeria the most popular is the groundnut paste popularly called okwuse. Ground nut paste locally called okwuse is a cherished delicacy in the Niger Delta and among the Igbos. It is usually prepared by frying healthy groundnut seeds and grinding the seeds in sterilized blender. The ground groundnut paste is usually flavored with different spices to give it the needed taste. The recipe could be eaten with garden egg, cucumber and any other food of interest (Fekria, 2009). The flow chart described for the preparation of groundnut cake is the same as carried out for the local okwuse with the difference seen in the addition of other plant products, the non-removal of the oil, and the consumption of the paste without further drying in the sun, and without formation of pellets from the groundnut paste. The groundnut paste is prepared both in the market place and at home and sold in the market, along road sides under unhygienic condition. This product is sold as long as they last without any knowledge of the shelf life and the associated deteriorating fungi (Chuku, 2011). It is based on this dearth of information on the shelf life of groundnut paste treated with different plant leaf samples that this study was carried out. The product being only rich in protein and oil does not make for a balanced diet and as such the need for value addition by incorporating some vital plant materials that could improve the quality of the product. If this is done, better quality product with increased shelf life would be obtained and should be able to take care of the dietary needs of the teaming population in Nigeria.

Materials and Methods

Preparation of Ground nut paste

Five kilograms of freshly harvested and shelled groundnut was purchased from the mile 3 markets in Port Harcourt metropolis and transported home at Ozuoba in Obio/Akpor Local Government Area, in Rivers State. The seeds were sorted and the bruised ones were removed from the unblemished ones. The seeds were wetted by sprinkling with water and small quantity of salt sprinkled on the seeds and mixed thoroughly and allowed to sun dry for one hour. The dry seeds were then fried in a metallic frying pan using a low heated local oven powered by fire wood. Care was taken to ensure that the seeds were well fried without allowing them to burn. Smooth frying was achieved by frying the groundnut seeds in garri. The fried seeds were allowed to cool before peeling. After peeling, the seeds were ground in manual blender and preserved for further studies (Chuku, 2011).

Collection and preparation of plant materials

Six plant materials were purchased from the mile 3 markets comprising three different leaf samples viz: bitter leaf, scent leaf and garden egg leaf. The leaf samples were washed and sun dried for three days. The leaf samples were crushed into powder by blending in a manual blender and each of the samples stored in a clean plastic container and labelled accordingly for further studies.

Determination of proximate and mineral composition of groundnut paste and the plant materials

The various prepared samples were taken to the Food Science and Technology Laboratory in the Rivers State University for analysis. The method of analysis used was the AOAC (2005).

Results and Discussion

Table 1: Effects of treatment of scent leaf on the proximate composition of groundnut paste.

Scent leaf	Moisture	Ash	CHO	Fibre	Lipid	Protein
Control	61.5±0.00^{b}	5.05±0.00^{a}	5.92±0.00^{a}	2.50±0.00^{a}	6.50±0.00^{a}	18.53±0.00^{a}
2g	9.92±0.658^{a}	5.42±1.17^{a}	22.41±1.19^{b}	3.39±1.19^{a}	11.62±1.07^{b}	44.61±1.03^{b}
4g	10.19±0.36^{a}	5.27±1.10^{a}	22.50±0.95^{b}	3.57±1.05^{a}	11.46±1.12^{b}	44.48±0.98^{b}
6g	8.88±0.63^{a}	4.50±0.85^{a}	21.48±0.71^{b}	2.37±0.76^{a}	12.01±1.30^{b}	43.59±0.87^{b}
8g	8.63±1.10^{a}	4.42±1.17^{a}	21.47±0.90^{b}	2.25±0.89^{a}	12.11±1.24^{b}	43.38±1.05^{b}
10g	9.81±1.95^{a}	4.69±1.07^{a}	21.42±1.15^{b}	2.33±0.66^{a}	12.47±0.90^{b}	43.37±0.88^{b}

LEGEND: CHO=carbohydrate

Table 2: Effects of treatment with bitter leaf on the proximate composition of groundnut paste

Bitter leaf	Moisture	Ash	CHO	Fibre	Lipid	Protein
Control	26.50±0.00^{b}	3.04±0.00^{a}	43.10±0.00^{b}	3.47±0.00^{bc}	5.56±0.00^{a}	18.53±0.00^{a}
2g	11.64±1.09^{a}	7.64±0.98^{b}	21.52±1.28^{a}	2.93±0.51^{bc}	10.74±0.93^{c}	38.66±0.74^{b}
4g	11.43±1.10^{a}	7.46±0.97^{b}	21.60±1.00^{a}	2.88±0.59^{a}	10.41±1.08^{b}	38.16±0.82^{b}
6g	10.93±0.58^{a}	6.05±1.64^{b}	19.90±0.53^{a}	1.74±0.57^{a}	8.18±1.00^{bc}	37.66±0.18^{b}
8g	10.73±1.05^{a}	5.80±1.54^{b}	17.99±4.72^{a}	1.78±0.63^{ab}	9.41±0.98^{c}	37.38±0.98^{b}
10g	10.73±1.26^{a}	6.33±0.95^{b}	17.77±7.00^{a}	2.00±0.53^{c}	11.00±1.97^{b}	37.19±0.62^{b}

LEGEND: CHO=carbohydrate

Table 3: Effects of treatment with garden egg leaf on the proximate composition of groundnut paste.

Garden egg leaf	Moisture	Ash	CHO	Fibre	Lipid	Protein
Control	80.10±0.00 [b]	4.45±0.00 [b]	5.57±0.00 [a]	4.60±0.00 [a]	4.23±0.00 [a]	1.05±0.00 [a]
2g	16.01±0.47 [a]	1.90±0.41 [a]	22.21±0.35 [b]	1.82±0.26 [a]	11.30±0.17 [b]	50.07±0.37 [b]
4g	15.82±0.44 [a]	1.70±0.36 [a]	21.60±0.72 [b]	1.72±0.23 [a]	10.95±0.23 [b]	48.76±1.35 [b]
6g	15.33±0.15 [a]	1.31±0.26 [a]	20.96±0.27 [b]	1.28±0.20 [a]	10.04±0.25 [b]	45.46±4.55 [b]
8g	15.24±0.48 [a]	1.51±0.43 [a]	20.80±0.52 [b]	1.20±0.13 [a]	9.70±0.61 [ab]	45.10±4.10 [b]
10g	9.94±8.65 [a]	1.30±1.25 [a]	13.93±12.08 [ab]	3.16±4.44 [a]	6.78±5.89 [b]	29.29±25.63 [b]

Table 4: Effects of treatment with scent leaf on the mineral composition of groundnut paste.

Scent leaf	Ca	Fe	P	K	Na	Mg
Control	1.50±0.00 [a]	3.10±0.00 [c]	42.10±0.00 [a]	3.82±0.00 [a]	3.50±0.00 [a]	4.00±0.00 [a]
2g	3.0±0.61 [a]	2.94±0.52 [c]	47.96±0.59 [b]	38.44±1.24 [b]	41.59±1.02 [b]	21.59±1.02 [b]
4g	2.80±0.72 [a]	2.77±0.47 [bc]	47.42±0.97 [b]	38.57±0.90 [b]	41.45±1.03 [b]	21.49±0.92 [b]
6g	4.10±4.07 [a]	1.86±0.34 [a]	46.87±0.55 [b]	37.36±1.22 [b]	40.43±0.68 [b]	20.62±0.82 [b]
8g	1.96±0.66 [a]	1.87±0.57 [a]	46.72±1.02 [b]	37.49±1.12 [b]	40.57±1.05 [b]	20.50±1.15 [b]
10g	2.08±0.91 [a]	2.09±0.45 [ab]	47.76±1.93 [b]	37.70±1.47 [b]	40.60±1.31 [b]	20.70±1.07 [b]

LEGEND: Ca=calcium, Fe=iron, P=phosphorus, K=potassium, Na=sodium and Mg=magnesium

Table 5: Effects of treatment with bitter leaf on the mineral composition of groundnut paste

Bitter leaf	Ca	Fe	P	K	Na	Mg
Control	6.13±0.00 [a]	4.20±0.00 [a]	4.23±0.000 [a]	3.77±0.00 [a]	3.50±0.00 [a]	4.70±0.00 [a]
2g	10.66±2.10 [b]	5.96±0.59 [c]	50.45±0.52 [b]	38.00±0.61 [c]	36.66±1.03 [b]	48.73±39.17 [b]
4g	11.41±0.91 [b]	5.80±0.58 [c]	50.09±0.59 [b]	37.50±1.07 [bc]	36.22±0.71 [b]	26.26±0.82 [ab]
6g	10.54±0.51 [b]	4.97±0.51 [bc]	49.47±0.50 [b]	36.63±0.58 [b]	34.90±1.19 [b]	25.34±0.93 [ab]
8g	10.62±0.69 [b]	4.87±0.56 [bc]	49.70±0.50 [b]	36.81±0.55 [bc]	35.25±1.19 [b]	25.53±1.05 [ab]
10g	10.51±0.98 [b]	5.03±0.81 [bc]	49.47±0.76 [b]	36.81±0.71 [bc]	35.35±1.35 [b]	25.48±1.03 [ab]

LEGEND: Ca=calcium, Fe=iron, P=phosphorus, K=potassium, Na=sodium and Mg=magnesium

Table 6: Effects of treatment with garden egg leaf on the mineral composition of groundnut paste.

Garden egg Leaf	Ca	Fe	P	K	Na	Mg
Control	1.60±0.00 [a]	4.00±.00 [a]	4.50±0.00 [a]	3.80±0.00 [a]	4.50±0.00 [a]	21.80±0.00 [a]
2g	14.98±0.31 [b]	18.68±0.67 [a]	15.26±0.36 [ab]	26.31±1.15 [ab]	40.26±.36 [b]	24.36±0.13 [a]
4g	14.98±0.45 [b]	18.32±0.87 [a]	14.99±0.52 [ab]	26.18±0.20 [ab]	40.01±0.62 [b]	24.28±0.16 [a]
6g	13.78±0.41 [b]	2.27±0.40 [a]	29.53±0.22 [b]	40.6±2.84 [b]	32.86±0.97 [ab]	23.27±0.37 [a]
8g	13.74±4.58 [b]	1.66±0.58 [a]	29.01±0.59 [b]	40.17±3.85 [b]	32.56±0.59 [ab]	23.04±0.70 [a]
10g	9.45±8.19 [b]	1.39±1.24 [a]	17.13±0.23 [ab]	24.75±4.83 [ab]	20.61±0.69 [b]	15.80±0.68 [a]

LEGEND: Ca=calcium, Fe=iron, P=phosphorus, K=potassium, Na=sodium and Mg=magnesium

Table 1 indicated the effects of treatment of groundnut pastes with scent leaf on the proximate composition. Results revealed the presence of moisture, with the highest value in control samples (61.5±0.00) and least in 6g concentration (7.81±1.95). However, highest value for ash was seen in 2g samples (5.42±1.17) while the least value (4.42±1.17) was recorded in 8g samples. Meanwhile, Carbohydrate recorded (22.50±0.95) being the highest value in 4g samples and (5.92±0.00) for the control. Fiber revealed (3.57±1.05) for 4g being the highest and 2.25±0.89 for 8g as the least value. The highest value of lipid was seen in the 10g which recorded 12.47±0.90, while 6.50±0.00 which was the least was got for the control. In addition to the above result, protein was seen to have 44.61±1.03 value at 2g as the highest

and 18.53±0.00 as the least at the control level. The above results of the treatment of groundnut paste with powdered scent leaf recorded that moisture drastically reduced, Ash and fiber were not affected, while Carbohydrate, lipid and protein significantly increased at ($p<0.005$).

Table 2 indicates the presence of moisture ranging from (10.73±1.05 to 26.50±0.00) with the control samples being the highest and 8g the least of the treated samples. A range of (3.04±0.00 to 7.64±0.98) for ash was obtained, the least and highest values at 2g and control of the treated samples respectively. Meanwhile, (17.77±7.00 to 43.10±0.0) was the range of values recorded for carbohydrate indicating control and 10g as the highest and least respectively. This was followed by (1.74±0.57 to 3.47±0.00) values range for fiber for which 6g and control were the least and highest respectively. The lipid concentrations observed were 5.56±0.00 to (11.60±1.97). Control and 10g being the least and highest recorded respectively. In addition to the above results, a range of (18.53±0.00 to 38.66±0.74) values for protein was observed with control and 2g obtaining the least and the highest respectively. This result of the effects of the treatment of groundnut paste with varying concentrations of ground bitter leaf samples recorded a reduction in moisture, fiber and carbohydrate (Eke-Ejiofor *et al*., 2012). However protein, ash and lipid values significantly increased more than the control ($p<0.005$).

Table 3 revealed the presence of moisture, with the highest value at the control level (80.10±0.00) and least at the 10g concentration (9.94±8.65). However, highest value for ash was seen in the control (4.45±0.00) while its least value (1.30±1.25) was seen in the 10g. Meanwhile, Carbohydrate recorded (22.21±0.35) for 2g as the highest value and 5.572±0.00 concentration at the control was the least recorded. fiber revealed (4.60±0.00) for control as the highest and (1.20±0.13) for 8g as the least value. The highest value of lipid was seen in the 2g which recorded (11.30±0.17) concentration while (4.23±0.00) which was the least was gotten for the control. In addition to the above result, protein was noted to have (50.07±0.37) concentration at the 2g as the highest and (1.05±0.00) concentration as the least at the control level. This result of the effects of the treatment of groundnut paste with varying concentrations of ground garden egg leaf samples recorded a reduction in moisture, ash, and fiber. Although, carbohydrate, lipid and protein recorded values that were significantly higher than the control ($p<0.005$). This also agrees with the findings of early researcher (Kane, 2012).

Tables 4 showed the presence of calcium ranging from (1.50±0.00 to 4.10±4.07) 6g being the highest and control the least of the treated samples. It also showed a range of (1.86±0.34 to 3.10±0.00) iron concentration, the least and highest values at 6g and control of the treated samples respectively. Nevertheless, (42.10±0.00 to 47.96±0.0) was the range of values recorded for phosphorus indicating control and 2g as the least and highest respectively. This was followed by (3.82±0.00 to 38.57±0.90) concentrations range of Potassium for which control and 4g were the least and highest respectively. The sodium concentrations observed were (3.50±0.00 to 41.59±1.02). Control and 2g being the least and highest recorded respectively. In addition to the above results, a range of (4.00±0.00 to 21.59±1.02) concentrations of magnesium was observed with 2g and control obtaining the highest and the least respectively. This result of the effect of treatment of groundnut paste with ground scent leaf recorded values that were significantly high for phosphorus, potassium, sodium and magnesium. Although, calcium value for the control was significantly similar in treatments with 8g and significantly low at 2, 4, 6and 10g. However, iron had values that were lower compared to the control. Similarly, the observation here is in line with the work of Singh, B.

(1992).

Tables 5 revealed the presence of calcium ranging from (6.13±0.00 to 11.41±0.91) with 4g being the highest and control the least of the treated samples. It also showed a range of (4.20±0.00 to5.96±0.59) iron values, the least and highest values at control and 2g of the treated samples respectively. Nevertheless (4.23±0.00 to 50.45±0.52) was the range of values recorded for phosphorus indicating control and 2g as the least and highest respectively. This was followed by (3.77±0.00 to 38.00±0.61) values range for Potassium for which control and 2g were the least and highest respectively. The sodium concentrations observed were (3.50±0.00 to 36.66±1.03). Control and 2g being the least and highest recorded respectively. In addition to the above results, a range of (4.70±0.00 to 48.73±3.17) concentrations of magnesium was observed with 2g and control obtaining the highest and the least respectively. This result of the effect of treatment of groundnut paste with ground bitter leaf gave values that were significantly high for phosphorus, potassium, sodium, calcium and magnesium. However, iron value for the control was significantly similar in treatments with 6 and 8g and significantly low at 2, 4and 10g.

Table 6 showed the presence of calcium with the least value at the control level, (1.60±0.00) and highest at the 4g concentration (14.98±0.45). The highest value for iron was seen in the 2g samples (18.68±0.67) while its least value (1.39±1.24) was seen in the 10g. However, phosphorus recorded (29.53±0.22) for 6g as the highest value and (4.50±0.00) at the control which was the least recorded. Potassium revealed (40.17±3.85) for 8g as the highest and (3.80±0.00) for control as the least value. The highest value of sodium was seen in the 2g which recorded (40.26±0.36) concentration while (4.50±0.00) which was the least was obtained for the control. In addition to the above result, magnesium was noted to have (24.36±0.13) value at the 2g as the highest and (15.80±0.68) as the least at the 10g concentration. This result of the effect of treatment of groundnut paste with ground garden egg leaf recorded values that were significantly high for phosphorus, potassium, sodium and calcium. However, iron value for the control was significantly high in treatments with 6 and 8g and significantly low at 6, 8 and 10g. Magnesium recorded greater value for 2, 4, 6 and 8g but less at 10g compared to the control. The results got from the addition of the various leaf powder to ground nut paste agrees with the findings of other researchers who reported that most vegetables are rich in minerals and other food materials for healthy living (Achinewhu, 1996, Chuku and Ugorji, 2012).

Conclusion

The result from this work revealed that the addition of the various leaf powders to groundnut paste reduced moisture an indication that they could prolong the shelf life of ground nut paste. Other nutrient elements and minerals were also affected. In general, the use of powdered scent leaf greatly improved the proximate parameters assessed on ground nut paste. However, the mineral composition of the ground nut paste was generally increased by the addition of powdered samples of bitter leaf at various concentrations.

From the result of this study, it is therefore recommended that for improved shelf life of ground nut paste, a combination of scent leaf and bitter leaf powder should be in-corporated for balanced diet.

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