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Taste profile and consumer preference of "dawadawa" produced from the seeds of *Parkia biglobosa*, *Glycine max* and *Hibiscus sabdariffa*

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ABSTRACT

Proteolytic process is a key step that influence taste profile of African condiments. This process involves the degradation of protein to yield free amino acids. Very few studies have made effort to determined how the amino acid taste profile influence the consumer preference of the condiments. The aims of this research is to analyse taste profile and consumer preference of "dawadawa'' produced by the fermentation of seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* to determine whether key taste characteristics influence consumer preference of the condiments. The analysis of amino acid of "dawadawa" produced from the seeds of locust beans (*Parkia biglobosa*), soya beans (*Glycine max*) and roselle (*Hibiscus sabdariffa*) was conducted to understand how the fermenting organisms ferment these unusual legumes seeds during condiment production and the role the organisms play in improving the free amino acids, flavour and consumer preferences for the condiments. The amino acid content was analysed using amino acid analyser and the sensorial analysis was performed using the Hedonic scale. Bitter taste profile was high in the condiment produced from *P. biglobosa* and *G. max*, followed by monosodium glutamate-like (MSG-like) and sweet taste in the respective condiments. The latter two seem to play greater role on the final taste profile of the condiment while higher concentration of MSG-like taste was observed in the locally produced condiments from the three seeds compared with the laboratory produced condiments. The laboratory prepared "dawadawa" from *P. biglobosa* and *H. sabdariffa* seeds was the most preferred than that prepared from the seeds of *G. max*. "Dawadawa" if properly developed have a strong potential of improving the nutritional status of the rural population and provide income to rural masses.
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Keywords: Dawadawa, taste, sweet amino acids, fermented condiments, *G. Max.*

INTRODUCTION

Proteolysis and lipolysis are well known principal and complex biochemical activities that occur during the fermentation of some legume seeds for condiment production. The products of lipid and protein degradation play a vital role on the nutritional status of these condiments while also directly contributing to the taste characteristics and in some cases, indirectly serve as aromatic products precursors (Kiers et al., 2000; Han et al., 2004). It is well documented in the

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literature that the majority of taste compounds such as salt and amino acids produced during proteolysis are contained in the water-soluble fraction (Kim and Lee, 2003), and the quality indices of many legume based fermented condiments such as free amino acids have been reported (Omafuvbe et al., 2000; Kim and Lee, 2003; Han et al., 2004, Ouoba et al., 2005, Ibrahim et al., 2011; Ojinnaka and Ojimelukwe, 2013).

Analysis of free amino acids and volatile organic compounds profile of dawadawan botso produced from *H. sabdariffa* seeds have been previously studied. Fermentation was found to increase the quantity of all essential amino acids except of threonine and an increase in the total free amino acid was also observed following fermentation of the *H. sabdariffa* seeds. The profile of bitter, sweet and MSG-like free amino acids in the unfermented and fermented seeds were also different (Ibrahim et al., 2011).

Similar approach has being exploited to analyse the free amino acid and volatile compounds of Chinese soy sauce (Yanfang and Wenyi, 2009). The study found that the bitter, sweet and MSG-like free amino acids values were significantly different in the soy sauces.

Proteolytic process is a key step that influence taste profile of African condiments. This process involves the degradation of protein to yield free amino acids. Very few studies have made effort to determined how the amino acid taste profile influence the consumer preference of the condiments. The aim of the present research was to study taste profile and consumer preference of dawadawa produced from the seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* and to determine whether key taste characteristics influence consumer preference of the condiments.

To the best of my knowledge on literature search, the present study is the only study that has exploited this approach to comparatively analyse three condiments commonly consumed in the Northern Nigeria.

MATERIALS AND METHODS

Sample collection

“Dawadawa” produced locally by the fermentation of seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* was collected each from two different sellers in Sokoto central market, Sokoto State, Nigeria. All the samples were placed inside sterile polytene bag separately and transported to microbiology research laboratory of Usmanu Danfodiyo University Sokoto.

Also three dawadawa were produced in the laboratory by the fermentation of seeds of *P. biglobosa*, *G. max* and *H. Sabdariffa* under laboratory conditions. All samples were subjected to further analysis.

The known sample each was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the Applied Biosystems PTH Amino Acid Analyzer (Benitez, 1989).

Defatting sample

Each sample was defatted using chloroform or methanol mixture of ratio 2:1. Three hundred (300) mg of the sample was put in extraction thimble and extracted for 15 hours in Soxhlet extraction apparatus (AOAC, 2006).

Nitrogen determination

A small amount (0.115 mg) of each ground sample was weighed, wrapped in Whatman filter paper (No.1) and put in the Kjeldhal digestion flask. Concentrated sulphuric acid (10 ml) was added. Catalyst mixture (0.5 g) containing sodium sulphate (Na_2SO_4), copper sulphate ($CuSO_4$) and selenium oxide (SeO_2) in the ratio of 10:5:1 was added into the flask to facilitate digestion. Four pieces of anti-bumping granules were added.

The flask was then put in Kjeldhal digestion apparatus for 3 hours until the liquid turned light green. The digested sample was cooled and diluted with distilled water to 100 ml in standard volumetric flask. Aliquot (10 ml) of the diluted solution with 10 ml of 45% sodium hydroxide was put into the Markham distillation apparatus and distilled into 10 ml of 2% boric acid containing 4 drops of methyl red indicator added until about 70 ml of distillate was collected.

The distillate was then titrated with standardize 0.01 N hydrochloric acid to grey coloured end point (Smyth et al., 1963).

Percentage Nitrogen = (a-b) x 0.01 x 14 x V x 100 W x C

Where :

a. = Titre value of the digested sample

b. = Titre value of blank sample

v. = Volume after dilution (100 ml)

W. = Weight of dried sample (mg)

C. = Aliquot of the sample used (10 ml)

14. = Nitrogen constant in mg.

Hydrolysis of the sample

About 1.0 g of the defatted sample was weighed into glass ampoule. 7 ml of 6 NHCl was added and oxygen was expelled by passing nitrogen into the ampoule (this is to avoid possible oxidation of some amino acids during hydrolysis e.g. methionine and cystiene).

The glass ampoule was then sealed with Bunsen burner flame and put in an oven present at 105 ± 5 °C for 22 hours. The ampoule was allowed to cool before broken open at the tip and the content was filtered to remove the humins.

The filtrate was then evaporated to dryness using rotary evaporator. The residue was dissolved with 5 ml to acetate buffer (pH 2.0) and stored in plastic specimen bottles, which were kept in the freezer.

Loading of the hydrolysate into analyzer

The amount loaded was 60 microliter of the filtrate in acetate buffer (hydrolysate) was loaded into the cartridge of the analyzer. The analyzer is designed to separate and analyze free acidic, neutral and basic amino acids of the hydrolysate.

Method of calculating amino acid values

An integrator attached to the Analyzer calculates the peak area proportional to the concentration of each of the amino acids.

Grouping of free amino acid

The taste characteristics performed as described previously (Tseng et al., 2005), amino acids were grouped as MSGlike (monosodium glutamate-like) (Asp+Glu), sweet (Ala+Gly+Ser+Thr), bitter (Arg+His+Ile+Leu+Met+Phe+Trp+Try+Val), and tasteless (Cys+Lys+Pro) (Ibrahim et al., 2011).

Defatting of *P. biglobosa, G. max* and *H. sabdariffa* seeds

The sample was defatted using N-hexane as solvent. Five grams of the sample was put into the extraction thimble and extracted for 15 hours in Soxhlet extraction apparatus (AOAC, 2006).

Fermentation of the defatted seeds of *P. biglobosa, G. max* and *H. sabdariffa*

Each of the defatted seeds was fermented as previously described.

Sensory evaluation

Sensory evaluation was performed as described previously (Njoku et al., 1991; Wokoma and Aziagba, 2002). One hundred panelist (consisting of males and females from six geographical zones of Nigeria) conversant with the condiment were selected and briefed about the aim of evaluation and how it should be conducted. The panelists were presented with the labeled samples: A, B, C, D, E and F. The attribute of the sample evaluated by the panelists were colour, texture, aroma, flavour, and general acceptability. The response was evaluated using 9- point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, 9 = like extremely).

Statistical analysis

Analysis of Variance (ANOVA) was used to analyse the data generated. Mean separation was accomplished by Duncan multiple range test for significant difference (P <0.05) using SPSS Software version?

RESULTS

The taste characteristic profile of locally and laboratory produced 'dawadawa' by fermenting seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* was analyzed and the results were presented in Figure 1, 2 and 3 respectively.

A comparative analysis of the impact of pre-processing on the taste characteristic profile of the condiment produced from the seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* was performed and demonstrated in Figure 4, 5 and 6 respectively.

Sensorial analysis of the local and laboratory produced dawadawa from the seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* were presented in Table 1.

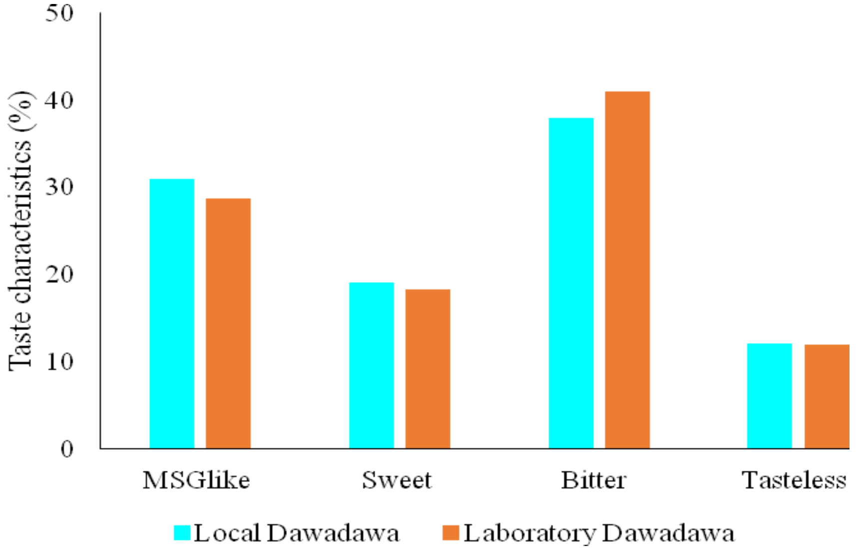

Figure 1: Taste characteristic profile of locally and laboratory produced "dawadawa" by fermenting seeds of *P. Biglobosa.*

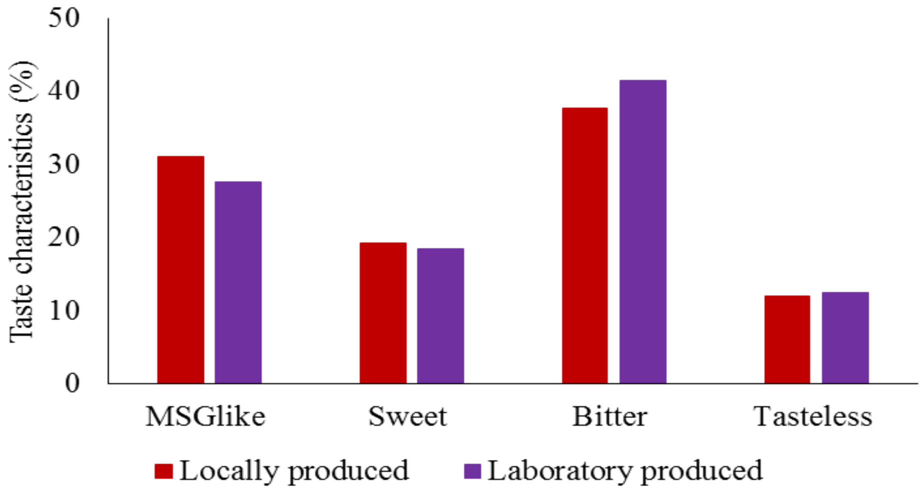

Figure 2: Taste characteristic profile of locally and laboratory produced "dawadawa" by fermenting seeds of *G. max.*

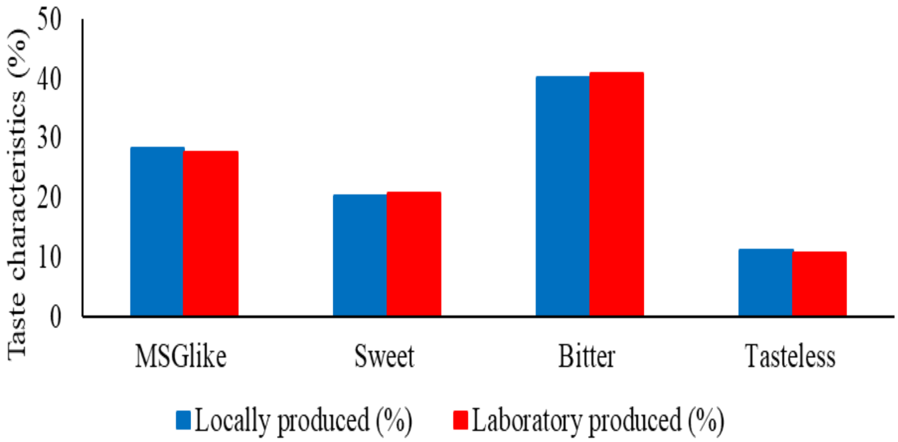

Figure 3: Taste characteristic profile of locally and laboratory produced "dawadawa botso'' by fermenting seeds of *H. Sabdariffa.*

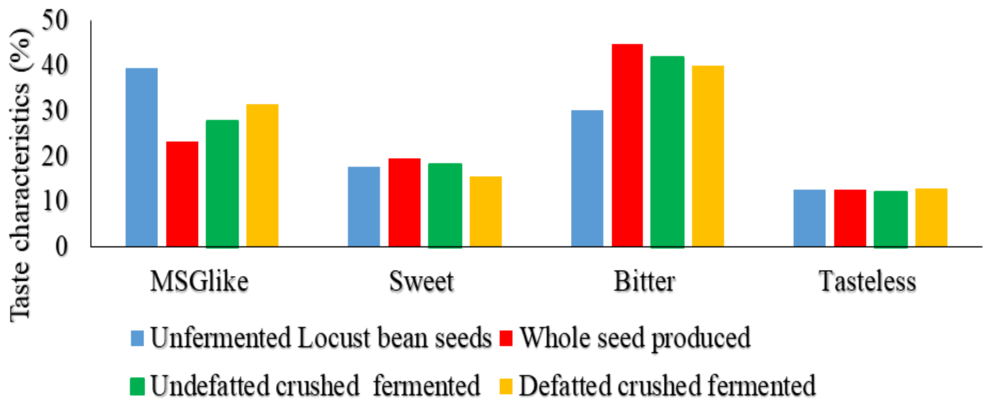

Figure 4: Taste characteristic profile of unfermented and fermented whole seeds, crushed defatted and un-defatted seeds of *P. biglobosa* seeds used for the production of "dawadawa".

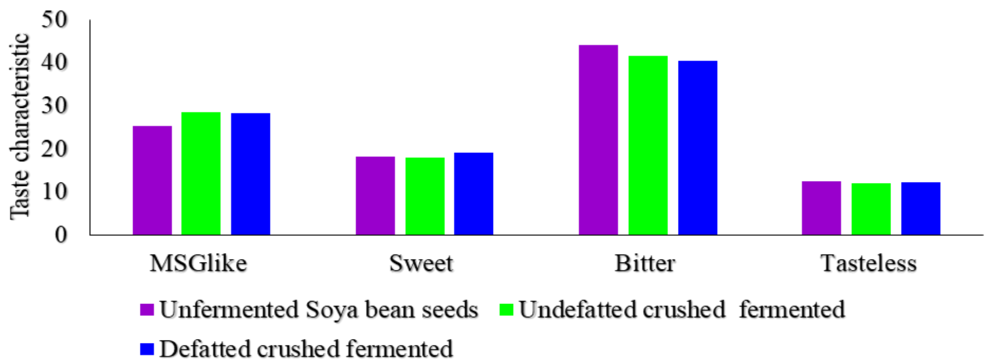

Figure 5: Taste characteristic profile of whole seeds, crushed defatted and un-defatted seeds of *G. max* used to produce "dawadawa".

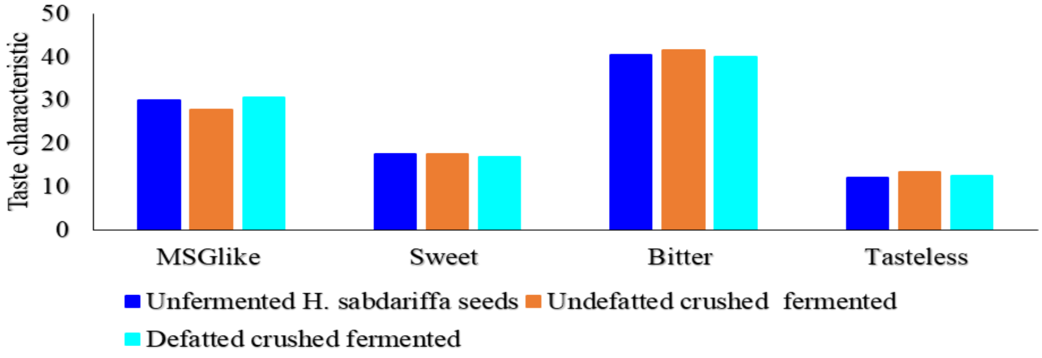

Figure 6: Taste characteristic profile of whole seeds, crushed defatted and un-defatted seeds of *H. sabdariffa* used to produce "dawadawa botso".

Table 1: Sensory evaluation of "daddawa" samples produced by the fermentation of the seeds of *P. biglobosa*, *G. max* and *H. Sabdariffa.*

Products	Colour	Texture	Aroma	Flavour	General acceptability
A	7.37[a]	6.87[b]	6.89[a]	6.79[a]	7.41[a]
B	5.47[c]	5.32[d]	4.95[c]	4.44[d]	3.35[c]
C	7.45[a]	7.48[a]	7.22[a]	6.79[a]	7.71[a]
D	6.16[b]	5.88[c]	5.87[b]	5.86[c]	6.52[b]
E	6.23[b]	6.03[c]	5.77[b]	5.63[c]	6.46[b]
F	7.06[a]	6.71[b]	6.07[b]	6.26[b]	6.90[b]
SEM	0.179	0.179	0.190	0.185	0.163
Sig	**	**	**	**	**

* Means followed by the same letter(s) along the rows are statistically similar ($p>0.005$).

Key: A- Locally produced dawadawa from the seeds of *P. biglobosa*
D- Laboratory produced dawadawa from the seeds of *P. biglobosa*
B- Locally produced dawadawa from the seeds of *G. max*
E- Laboratory produced dawadawa from the seeds of *G. max*
C- Locally produced dawadawa from the seeds of *H. sabdariffa*
F- Laboratory produced dawadawa from the seeds of *H. sabdariffa*

DISCUSSION

"Dawadawa" if properly developed have a strong potential of improving the nutritional status of the rural population and provide income to rural masses. The result of the present study shows that the bitter followed by monosodium glutamate-like (MSG-like) and sweet taste were the dominant taste in the produced condiments irrespective of the seed choice. However, the locally produced condiments from the three seeds had higher concentration of MSG-like taste compared with the laboratory produced condiments and sweet taste was lower in the locally produced "dawadawa" from *P. biglobosa* and *G. max* and higher only in laboratory produced dawadawa from *H. sabdariffa* seeds. Bitter taste was always the highest of all the taste profiles of the condiments.

However, by comparing the impact of pre-processing on the taste characteristic profile of the produced condiment, the unfermented seeds *P. biglobosa* had the highest level of MSG-like and less bitter taste. The crushed, defatted and fermented seeds of

P. biglobosa had comparable MSG-like taste to the whole unfermented with lesser bitter taste compared with other treatments of the study. The tasteless profile seems to be within a comparable arrange across all the seeds and pre-processing methods. With *G. max,* higher MSG-like and sweet taste were observed with lesser bitter taste. The crushed defatted *H. sabdariffa* seeds produced condiment had higher MSG-like and lesser bitter taste when compared with other treatments with the same group.

The higher concentration of MSG-like taste observed in the locally produced condiments from the three seeds compared with the laboratory produced condiments was probably due to the higher content of aspartic and glutamic acids. The observation has been made before in a *Ganoderma tsugae* (Tseng et al., 2005). The higher sweet taste amino acids observed only laboratory- produced "dawadawa" from *H. sabdariffa* seeds maybe linked to the ash leachate that was added. Sweet amino acid taste profile has been reported to decrease in fermented *H. sabdariffa* seeds when compared with unfermented seeds during the production of "dawadawa'' (Ibrahim et al., 2011). The higher level of MSG-like and less bitter taste observed in the crushed defatted and fermented seeds could be as a result of the fact that the amino acids that account for these taste characteristics of the condiment are also intermediate used by the fermenting organisms for biotransformation during the production of volatile flavor compounds for the condiments. This observation has been made previously during the fermentation for cheese production (Tavaria et al., 2002).

By comparing the sensorial attributes of the local and laboratory produced "dawadawa'' from the seeds of *P. biglobosa, G. max* and *H. Sabdariffa,* it has been observed that in terms of the colour, no significant differences was found in the colour of product A, C, E and F despite the fact that they were produced using the different seeds. In terms of general acceptability, the laboratory produced "dawadawa'' from the seeds of *P. biglobosa*, *G. max* and *H. sabdariffa* were accepted on the same scale and the locally produced condiment from the seeds of *P. biglobosa* and *H. sabdariffa* were equally accepted on the same scale leaving behind locally produced condiment from the seeds of *G. max*.

The ANOVA result for sensory evaluation shows that sample A, C and F have the highest colour score while the least score was obtained in sample B. Based on texture sample C has the highest score while sample B have the least score. Aroma result shows sample A and C having the highest score and sample B having the least score. Similarly in terms of flavour, sample A and C were found to have the highest score while sample B was found to be with the least score. Result of general acceptability of the products shows sample A and C were having the highest score and sample B having the least score. From the overall result, there is significant difference between all the parameters being evaluated by the panelists. The chi-square (X^2) shows significant association/relationship between the product types and the scoring of the parameter by the panelists. The results show that there is significant difference in terms of the product quality. The variation in percentage acceptability or dislike of a particular product is statistically valid and significant ($P \leq 0.005$).

Conclusion

Locust beans (*P. biglobosa*), soya beans (*G. max*) and Roselle seed (*H. Sabdariffa*) were processed to produce "dawadawa'' using both traditional and laboratory fermentation procedure. Fermentation was found to increase the bioavailability of more essential amino acids and some non-essential amino acids. Bitter taste profile was high in the condiment produced from *P. biglobosa* and *G. max*, followed by monosodium glutamate-like (MSG-like) and sweet taste in the respective condiments. The latter two seem to play greater role on the final taste profile of the condiment while higher concentration of MSG-like taste was observed in the locally produced condiments from the three seeds compared with the laboratory produced condiments. The laboratory prepared "dawadawa'' from *P. biglobosa* and *H. sabdariffa* seeds was the most preferred than that prepared from the seeds of *G.max*. "Dawadawa" if properly developed has a strong potential of increasing food production, improving the nutritional status of the rural population and provide income to rural masses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

ASA conducted the research work with support from IAD. IAD, AAF and MAM designed the research work. ASA and IAD wrote the first draft of the manuscript. All authors contributed equally in writing the article.

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