American Journal of Food Technology

ISSN 1557-4571

Academic Journals Inc.

www.academicjournals.com

American Journal of Food Technology 2 (5): 440-445, 2007
ISSN 1557-4571

Evaluation of Biochemical Deterioration of Locust Bean Daddawa and Soybean Daddawa-Two Nigerian Condiments

[1]A.L. Kolapo, [2]T.O.S. Popoola and [1]M.O. Sanni
[1]Department of Biology, The Polytechnic, Ibadan, Nigeria
[2]Department of Microbiology, University of Agriculture, Abeokuta 110001, Nigeria

Abstract: Some functional properties were used to assess and compare biochemical deterioration in stored locust bean daddawa and soybean daddawa which are two popular fermented Nigerian condiments. The condiments were stored for 14 days at ambient temperature after the normal 72 h of fermentation and at 2 days interval assessed for pH, titratable acidity, free fatty acids (FFA), peroxide values (POV) as well as fat and water absorption capacities. The pH of both samples increased in the alkaline range, so also the titratable acidity. Peroxide values and FFA of the two condiments also increased significantly with storage, with those of soybean daddawa being significantly ($p<0.05$) higher. Water and fat absorption capacities of the fermented products decreased with storage. Differences recorded in values of fat absorption capacities was also significant ($p<0.05$). The implications of the recorded values of fatty acids, peroxidation and other functional properties monitored are discussed in relation to the perceived faster deterioration and poor acceptance soybean daddawa.

Key words: Soybean daddawa, *Glycine max*, *Parkia biglobosa*, fermentation, condiments, deterioration

INTRODUCTION

In recent years, the use fermented food condiments and flavouring agents are becoming popular in the diets of many nations. Apart from the fact that condiments improve sensory properties of foods, they add to the nutritional values providing dietary fibre, energy, minerals and vitamins. Also, some of them contain antioxidants and nutraceuticals that provide health benefits. Condiments of plant sources rich in protein are ways of incorporating protein into diets, particularly in African countries where most of the staple foods are starchy. Various types of condiments which are products of fermented seeds that are in use in Africa and some other parts of the world depending on the available raw materials and cultural background include; Kinema in Nepal (Tamang, 2000), Tooa-nao Thailand (Yokotsuka, 1991), Oso in south western Nigeria (Popoola *et al*., 2006) and Soumbala in Burkina Faso (Ouoba *et al*., 2003).

In Nigeria, two popular condiments which are also commonly used as taste enhancer in soups are fermented locust beans (*Parkia biglobosa*), popularly known as Iru (or locust bean daddawa) and fermented soybean (*Glycine max*) popularly known as soybean daddawa. Until recently, the popularity and acceptance of Locust bean daddawa was not in doubt as it is used in soups by communities in several parts of the country. However, the supply of locust bean is dwindling and in recent years it's been in short supply. This has lead to the search for an alternative raw material for preparing the well-liked condiment (Obatolu *et al*., 1998). As a result, the popularity of soybean daddawa which is considered as a suitable alternative began to soar. The popularity of soybean

Corresponding Author: T.O.S. Popoola, Department of Microbiology, University of Agriculture, Abeokuta 110001, Nigeria Tel: 234-803-3280991

daddawa is further encouraged by the fact that the preparation of locust bean daddawa is tedious and time consuming. The use of soybean as an alternative to *Parkia biglobosa* is also seen as a way of incorporating soybean protein into local diets (Achi, 2005). However, the popularity of soybean daddawa is marred by the perception that it is prone to faster deterioration than locust bean daddawa; at the end of the fermentation period (Popoola *et al*., 2007). Generally speaking, both condiments are products of spontaneous alkaline fermentation and they are organoleptically similar (Omabuvfe *et al*., 2007). The two products are used in the same way as food additives. The fermentation of both products is carried out by *Bacillus* species. *Bacillus substilis* was encountered and used as starter culture for the production of locust bean daddawa (Ikenebomeh *et al*., 1986; Ogbadu and Okagbue, 1988). This bacterial species was also encountered has been used as starter culture for preparing soybean daddawa (Omabuvfe *et al*., 2002).

There have been reports on methods of improving the shelf life of locust bean daddawa (Ikenebomeh, 1989) as well as that of soybean daddawa (Omabuvfe, 2007; Kolapo *et al*., 2007). However, there is no information on the biochemical deterioration of these popular condiments. This study was therefore carried out to investigate and compare biochemical changes in stored locust bean daddawa and soybean daddawa after 72 h of fermentation. This is with a view to providing scientific information on deterioration of the condiments. It is envisaged that the study will give an insight into possible ways of improving the shelf life of soybean daddawa in particular and encourage its acceptability.

MATERIALS AND METHODS

Collection of Seeds and Preparation of Daddawa

Soybean seeds (variety TGX 1440-2E) used for the study were obtained from the Institute of Agricultural Research and Training (IART), Moor Plantation, Ibadan. Nigeria. Locust bean seeds were procured from a local market. The condiments were prepared in the Microbiology laboratory of the University of Agriculture, Abeokuta. Soybean daddawa was prepared using the procedure described by Popoola and Akueshi (1985) while locust bean daddawa was produced using the traditional methods of Edema and Fawole (2006).

Biochemical/Physicochemical Investigations

pH value, titratable acidity (TA), free fatty acid (FFA) and peroxide content of stored products were monitored for 14 days after the normal 72 h of fermenting the seeds into daddawa. Samples were taken for analysis at two days interval. The pH values and titratable acidity were assessed using the methods of Ikenebomeh *et al*. (1986). The free fatty acid content (as % oleic acid) and peroxide values (meq kg^{-1}) were estimated using alkali titration with 0.1 M sodium thiosulphate solution using starch as indicator (AOAC, 2000). The fat and water absorption capacity of the samples were determined using the centrifugation method previously described by Sosulki *et al*. (1976). All determinations were carried out in triplicates and mean values were calculated.

Statistical Analysis

Data obtained were expressed as the mean±standard deviation (SD). The statistical significance of differences ($p<0.05$) between the treatments was assessed using the student t-test; means within a treatment were separated by Duncan Multiple range test using SPSS 9.0 for Windows.

RESULTS AND DISCUSSION

In both stored locust bean and soybean daddawa, the pH and titratable acidity (TA) increased with days of storage (Table 1). The observed pH changes in both soybean and locust bean daddawa

Table 1: pH and titratable acidity (mg lactic acid g^{-1}) of locust bean and soybean daddawa

	Locust bean daddawa		Soybean daddawa	
Storage time (day)	pH	Titratable acid	pH	Titratable acid
0	7.41[e]	0.039[e]	7.89[e]	0.050[f]
2	7.66[d]	0.077[d]	8.15[d]	0.055[e]
4	7.82[c]	0.073[d]	8.20[c]	0.075[d]
6	7.95[b]	0.085[c]	8.21[c]	0.074[d]
8	7.94[b]	0.088[c]	8.23[c]	0.101[c]
10	8.15[a]	0.097[b]	8.30[b]	0.104[c]
12	8.14[a]	0.101[b]	8.40[a]	0.119[b]
14	8.17[a]	0.114[a]	8.31[b]	0.139[a]

Values are means of three replicates. Means with different alphabets along columns are significantly different at $p<0.05$

Table 2: Peroxide values (meq kg^{-1}) of stored locust bean and soybean daddawa

Storage time (days)	Locust bean daddawa	Soybean daddawa
0	2.10±0.57[e]	3.56±0.28[f]
2	2.37±0.28[e]	4.60±0.42[f]
4	2.53±0.14[e]	6.50±0.14[e]
6	8.40±0.10[d]	13.59±0.28[d]
8	9.20±0.13[d]	14.60±0.42[d]
10	12.12±0.10[c]	18.68±0.98[c]
12	13.97±0.57[b]	20.28±0.25[c]
14	17.95±0.84[a]	28.70±0.84[a]

Values are means±standard deviation of three replicates. Means with different alphabets are significantly different at $p<0.05$

is similar to the reported trend for the fermentation of the two legumes for production of daddawa (Omabuvfe *et al*., 2000; Sarka *et al*., 1993; Ikenebomeh *et al*., 1986; Oyeyiola, 1988). In these earlier studies, increase in pH during fermentation has been attributed to the proteolytic activities and the release of ammonia by the fermenting *Bacillus* sp. The release of ammonia and other related end products have been reported as a common feature of vegetable protein fermentation (Hesseltine, 1965). The observed result in the present study is an indication that fermentation still continued in post processing period of soybean and locust bean daddawa. This is probably to be expected as the organisms are still present on the products at consumption. Differences observed in pH with storage and with the types of daddawa were significant ($p<0.05$), with that of soybean daddawa being significantly higher.

The observed increase in the titratable acid of both products with storage implies that some acid producing activities were on going in the products. An earlier report on biochemical deterioration of soybean daddawa has indicated that both acid and alkaline fermentation were superimposed in the stored soybean daddawa (Popoola *et al*., 2007). However, results from the present study indicates that the rate of acid and alkaline fermentation in stored locust bean daddawa is slower compared to soybean daddawa. This could be a reason why the latter is prone to quick deterioration and therefore has a shorter shelf life.

Peroxidation in stored contents of locust bean and soybean daddawa increased with storage days, however a drastic change was observed between 4th and 6th day of storage (Table 2). Zia-ur-Rehman *et al*. (2003) reported that an increased in peroxide value is a good predictor of fat deterioration. Thus, the observed increase in peroxide values with the storage period is an indication that peroxidation is associated with daddawa spoilage. The observed peroxide content is significantly higher in soybean daddawa ($p<0.05$). The implication is that fatty acids in soybean daddawa are more likely to deteriorate faster that those of locust bean daddawa. This may be another reason responsible for its quicker deterioration.

The FFA contents in locust bean and soybean daddawa increased progressively and significantly ($p<0.05$) with storage time (Table 3). However, the FFA content of stored soybean daddawa was significantly higher ($p<0.05$). Soybean daddawa is rich in oil (Popoola and Akueshi, 1986). The

Table 3: Free Fatty Acids (FFA)* of stored locust bean and soybean daddawa

Storage time (days)	Locust bean daddawa	Soybean daddawa
0	0.019±0.001^{g}	0.024±0.001^{f}
2	0.024±0.001^{f}	0.028±0.001^{ef}
4	0.025±0.001^{f}	0.034±0.002^{e}
6	0.035±0.000^{e}	0.052±0.005^{d}
8	0.040±0.002^{d}	0.061±0.001^{c}
10	0.043±0.001^{c}	0.065±0.002^{bc}
12	0.048±0.001^{b}	0.068±0.001^{ab}
14	0.056±0.001^{a}	0.072±0.001^{a}

Values are means±standard deviation of three replicates. Means with different alphabets are significantly different at $p<0.05$.
*FFA recorded as % oleic acid in sample

Table 4: Water and fat absorption capacities in stored locust bean and soybean daddawa

	Locust bean daddawa		Soybean daddawa	
Storage time (days)	WAC*	FAC♦	WAC	FAC
0	250^{a}	1.5^{a}	210^{a}	1.0^{a}
2	235^{b}	1.6^{a}	200^{b}	0.8^{ab}
4	220^{c}	1.4^{ab}	187^{c}	0.7^{bc}
6	193^{d}	1.3^{ab}	167^{d}	0.7^{bc}
8	167^{e}	1.4^{ab}	160^{d}	0.7^{bc}
10	160^{f}	1.2^{bc}	150^{e}	0.6^{bc}
12	147^{g}	1.0^{c}	138^{f}	0.6^{bc}
14	140^{h}	1.0^{c}	120^{g}	0.5^{c}

Values are means of three replicates. Means with different superscript alphabets are significantly different at $p<0.05$.
*WAC = Water Absorption Capacity (%); ♦FAC = Fat Absorption Capacity (mL g^{-1})

formation of organic acids and free fatty acids is an initial step in fat deterioration, development of rancidity and off-flavour in fatty foods (Sattar and Demen, 1973). Fatty acid formation was in most cases higher in soybean daddawa than in locust bean daddawa. This is an indication that rancidity and off-flavour will set in earlier and faster in soybean daddawa. This may explain why deterioration becomes more noticeable in soybean daddawa and why poor storage ability of the product is easily noticed. More susceptible to oxidation are the unsaturated lipids because of the presence of double bonds which make the fatty acid molecules particularly reactive with formation of the free radicals and derived oxidized compounds (Tomassi, 1988).The relatively higher content of polyunsaturated fatty acids in soybean (Asiedu, 1989) could be responsible for higher lipid oxidation observed in soybean daddawa. In this regard, the nutritional advantage of poly-unsaturated fatty acids in soybean could have a negative influence in stored soybean daddawa as secondary oxidative compounds may have a role to play in deterioration of the product.

A gradual and significant decrease ($p<0.05$) was observed in Water Absorption Capacity (WAC) of stored locust bean and soybean daddawa. However, there was no significant difference ($p>0.05$) between the values reported for the two products (Table 4). A similar trend was observed with values recorded for Fat Absorption Capacity (FAC) of the stored products. Except that there was a significant difference ($p<0.05$) between the two products. WAC is an indication of a product to associate with water in conditions where water is limiting (Giami, 1993) while FAC could be attributed to the physical entrapment of oils which is related to number of non-polar side chains on the proteins that bind hydrocarbon chains of the fatty acids. Fat acts as flavour retainer and increase mouth feel of foods (Kinsella, 1976), consequently a decrease in FAC of stored daddawa may be negatively impacting on its much desired functional attributes. In this respect, the significantly lower values ($p<0.05$) of FAC in soybean daddawa during storage probably contributes to its poor acceptability compared to locust bean daddawa.

CONCLUSION

The results of this study have shown that the functional properties monitored (particularly free fatty acids and peroxide values) as indices of deterioration was in most cases significantly higher in soybean daddawa than in locust bean daddawa. This may useful in explaining why soybean daddawa deteriorates faster than locust bean daddawa and the subsequent effect on its acceptability. This study will hopefully give an insight into ways of working out a practicable method of preserving soybean daddawa as well as extend its shelf life so as to benefit from its advantages over locust bean daddawa.

REFERENCES

Achi, O.K., 2005. Traditional fermented protein condiments in Nigeria. Afr. J. Biotechnol., 4: 1612-1621.

AOAC, 2000. Official Methods of Analysis, of AOAC International. 17th Edn., Gaiherburg, MD. Assocciation of Official Analytical Chemist,Washington DC.

Asiedu, J.J., 1989. Processing Tropical Crops: A Technical Approach, Macmillan.

Edema, M.O. and O. Fawole, 2006. Evaluation and optimization of critical control points in the production of Iru. Res. J. Microbiol., 1: 503-511.

Giami, S.Y., 1993. Effect of processing on the proximate composition and functional properties of cowpea (*Vignia unguiculata*) flour. Food Chem., 47:153.

Hesseltine, C.W., 1965. A millennium fungi, food and fermentation. Mycologia, 59: 149-197.

Ikenebomeh, M.J., R. Kok and J.M. Ingram, 1986. Processing and fermentation of the African Locust Bean (*Parkia filicoidea* Welw) to produce Dawadawa. J. Sci. Food Agric., 37: 273-283.

Ikenebomeh, M.J., 1989. The influence of salt and temperature on the natural fermentation of African locust bean. Int. J. Food Microbiol., 8: 133-139.

Kolapo, A.L., T.O.S. Popoola, O.M. Sanni and R.O. Afolabi, 2007. Preservation of soybean daddawa condiment with dichloromethane extract of ginger. Res. J. Microbiol., 2: 254-259.

Kinsella, J.E., 1976. Functional Properties of proteins in foods. A survey. Crit. Rev. Food Sci. Nutr., 7: 219.

Obatolu, V.A., S.M. Osho and A.C. Uwagbuete, 1998. Comparative Physicochemical Properties of Fermented Soybean and Locust Bean. In: Post- Harvest Technology and Commodity Marketing. Ferris, R.S.B. (Ed.), IITA Ibadan, pp: 163-168.

Ogbadu, L.J. and R.N. Okagbue, 1988. Bacterial fermentation of soybean for daddawa production. J. Applied Bacteriol., 65: 353-356.

Omabuvfe, B.O., O.O. Shonukan and S.H. Abiose, 2000. Microbiological and biochemical changes in the traditional fermentation of soybean daddawa. A Nigerian Food Condiment. Food. Microbiol., 17: 469-474.

Omabuvfe, B.O., S.H. Abiose and O.O. Shonukan, 2002. Fermentation of soybean (*Glycinemax*) for soy-daddawa production by starter cultures of *Bacillus*. Food. Microbiol., 19: 561-566.

Omabuvfe, B.O., E.O. Esosuakpo, T.S. Oladejo and A.A. Toye, 2007. Effect of soaking and roasting dehulling methods of soybean on Bacillus fermentation of soy-daddawa. Am. J. Food Microbiol., 2: 257-264.

Ouoba, L.I.I., K.B. Rchinger, V. Barkholt, B. Diawara, A.S. Traore and M. Jakobsen, 2003. Degradation of proteins during the fermentation of African locust bean (*Parkia biglobosa*) by strains of *Bacillus subtilis* and *Bacillus pumilus* for the production of Soumbala. J. Applied Microbiol., 94: 396-402.

Oyeyiola, G.P., 1988. Microbiology of the fermentation of Iru pete and Iru woro obtained from local producers. Mircen J. Applied Microbiol. Biotechnol., 4: 439-455.

Popoola, T.O.S. and C.O. Akueshi, 1985. Microorganisms associated with the fermentation of soybean for the production of Soybean Daddawa (A condiment). Nig. Food J., 2: 194-196.

Popoola, T.O.S. and C.O. Akueshi, 1986. Nutritional evaluation of Daddawa, a local spice made from soybean (*Glycine max*). Mircen J., 2: 405-409.

Popoola, T.O.S., A.A. Jolaoso, R.O. Afolabi and A.K. Akintokun, 2006. Microbiological studies on the production of Oso: A condiment made by fermenting seeds of *Cathormion altissimum*. J. Herbs Spices Med. Plants, 12: 129-138.

Popoola, T.O.S., A.L. Kolapo and O.R. Afolabi, 2007. Biochemical deterioration of soybean daddawa-A condiment. J. Food Agric. Environ., 5: 67-70.

Sarkar, P.K., P.E. Cook and J.C. Owens, 1993. *Bacillus* fermentation of soybean. World J. Microbiol. Biotechnol., 9: 295-299.

Sattar, D. and J.M. Demen, 1973. Effect of packaging material on light induced quality deterioration of milk. J. Can. Sci. Technol. Alim., 6: 170-174.

Sosulki, F., E.S. Humbert and K. Bui, 1976. Functional Properties of Rape seed Flours, concentrates and Isolates. J. Food Sci., 41: 1349-1352.

Tamang, J.P., 2000. Microbial diversity associated with natural fermentation of Kinema. Proc. 3rd Int. Soyabean Processing and Utilization Conf. Tsukubo, Japan Oct. 15-20, 2000, pp: 713-717.

Tomassi, G., 1988. Nutritional and Safety Aspect of Natural Antioxidants. In: Nutritional and Toxicological Aspects of Food Processing. Walker, R. and E. Quattruci (Eds.), Taylor and Francis. Basingstoke, pp: 1-13.

Yokotsuka, T., 1991. Proteinaceous Fermented Foods and Condiments Prepared with Koji Moulds. In: Handbok of Applied Mycology. Vol. 3. Food and Feeds, Arora, D.K., K.G. Mukerji and E.H. Marth (Eds.), New York Marcel Dekker, pp: 329-373.

Zia-ur-Rehman, A.M. Salariya and F. Habib, 2003. Antioxidant activity of ginger extract in sunflower oil. J. Sci. Food Agric., 83: 624-629.