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Storage Stability of Dakuwa

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Abstract

The storage stability of dakuwa was investigated. Dakuwa was prepared by malting and milling maize grains and groundnut. Maize flour and groundnut paste were mixed together in equal ratios with the addition of sugar and granulated red pepper. Dakuwa was packaged in low density and high density polyethylene bags and stored at 32 ± 4^0C for six months. Peroxide value, pH and sensory properties of dakuwa were determined monthly. The peroxide value of the samples increased continuously for four to five months and then decreased while the pH decreased all through the storage period. Changes in peroxide value and pH were lowest in samples packaged in high density polyethylene. The mean scores for sensory properties of the samples decreased throughout the period of storage. Dakuwa should be packaged in high density polyethylene bags and should not be stored for more than four months.

Keywords: Storage, dakuwa, lipid oxidation, pH, sensory properties

1. Introduction

Snacks are sweet or savoury foods eaten to provide light sustenance in a quick and convenient format, eaten between or as an alternative to main meals (IFIS, 2005). Snack foods are essential vehicles for delivery of essential nutrients because of the growing change in eating habits (Henshaw and Agunbiade, 2004).

Dakuwa is a cereal and groundnut based snack prepared at home by vendors and consumed mainly in the northern parts of Nigeria. Dakuwa is prepared from mixtures of cereals (maize, millet and sorghum), tigernuts, groundnut, ground pepper, ginger, sugar and salt (Nkama and Gbenyi, 2001). The ingredients are thoroughly mixed, pounded and moulded into balls that can be eaten without further processing (Abdulrahman and Kolawole, 2003). In Nigeria, dakuwa, like other snack foods, is mainly produced and consumed in its areas of production and production is based on art rather scientific knowledge, varies with people, culture and geographical locations: these leads to possession of variable characteristics (Ingbian and Akpapunam, 2005). Some of the problems associated with the local production of snacks such as dakuwa include non standardization of equipment, process and raw material, inadequate hygiene during and after production, and little or no packaging which results in poor preservation techniques and high levels of contaminants in the food resulting in food borne illnesses. According to Nkama and Gbenyi (2001) the local production of dakuwa does not take into consideration the presence of anti-nutrients such as phytate and tannins as a cereal/legume based product. This stimulated a survey of the traditional methods of processing dakuwa and an assessment of traditionally produced dakuwa in Niger State, north central Nigeria (Ocheme et al., 2011a and Ocheme et al., 2011b). These authors reported that 74% of local producers of dakuwa usually package the product while 26% do not package the product in any form. Furthermore, 87% of those who package the product use low density polyethylene while 13% use all kinds of paper. In addition to these studies, the moisture sorption characteristics of dakuwa have been reported (Ocheme et al., 2013). Further more, Ocheme et al. (2014) studied the effect of pH on the acceptability of dakuwa using accelerated storage tests.This study is aimed at evaluating the shelf life of dakuwa under ambient storage conditions in different packaging materials.

2. Materials and Methods

2.1 Materials

The maize (yellow variety) and groundnut (redskin) used for preparing dakuwa were obtained from local farmers at Gidan Kwano, Chanchaga Local Government area of Niger State, Nigeria while the sugar and granulated red pepper were obtained from Minna Central Market, Minna, Nigeria

2.2 Preparation of dakuwa

Maize grains and groundnut were manually cleaned. They were then washed in tap water and 400g each were soaked in 2litres of water for 12 hours after which they were germinated for 72 hours. At the end of germination, the maize and groundnut seeds were oven dried at 60^0C for sixty minutes. The groundnut seeds were roasted at 140^0C for thirty minutes while the maize was roasted at 140^0C for sixty minutes. The groundnut was decoated after which both maize and groundnut were milled separately using a local attrition mill. After milling, the maize flour was sieved to obtain a particle size of 0.05mm. The maize flour and groundnut paste were then mixed together in a 1:1 ratio. To 100g of this mixture, 10% and 5% respectively of granular sucrose and powdered red pepper were added, thoroughly mixed together and moulded into balls. The dakuwa balls were then packaged in low and high density polyethylene while some were left unpackaged.

2.3 Storage studies

Dakuwa balls were packaged in low density polyethylene (LDP) of 0.030mm thickness and high density polyethylene (HDP) of 0.08mm thickness at ambient temperature (32 ± 4^0C) for six months. Peroxide value and pH measurements as well as sensory evaluations were carried out monthly. The peroxide value of dakuwa was determined according to the method described by Kirk and Sawyer (1993) while the pH was determined by means of a pH meter (model CP90: Century Instruments Limited, Mumbai, India). A twenty-member panel consisting of students and Staff of Food Science and Nutrition option, department of Animal Production Federal University of Technology, Minna, Nigeria was selected based on their familiarity with dakuwa for the sensory evaluation. Dakuwa samples were presented in coded white plastic plates. The order of presentation of samples to the panel was randomized. Tap water was provided to rinse the mouth between evaluations. The panellists were instructed to evaluate the coded samples colour, aroma, taste and overall acceptability. Each sensory attribute was rated on a 7-point Hedonic scale (1=disliked very much while 7 = liked very much) as described by Iwe (2002).

All data were subjected to analysis of variance (ANOVA) by means of MINITAB 14 statistical software.

3. Results and Discussion

3.1Peroxide value (PV)

The PV of dakuwa during ambient storage is shown in Figure 1.

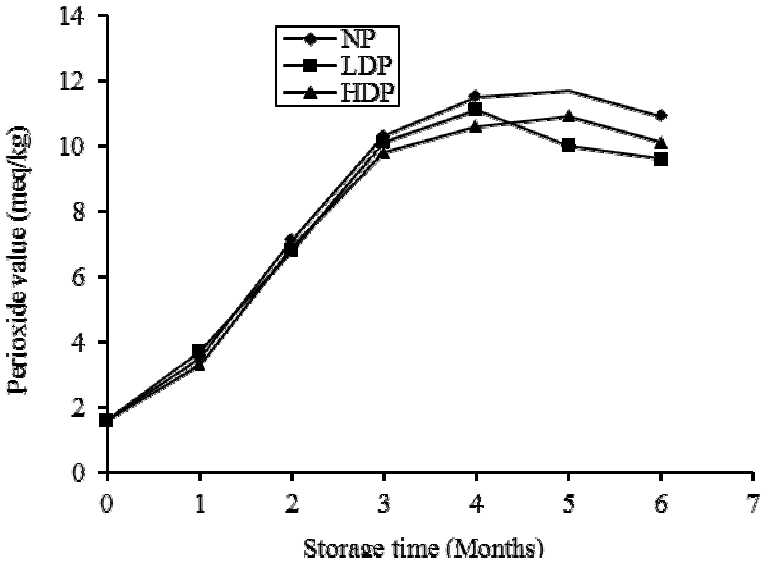

Figure 1: Peroxide values of *dakuwa* under storage

The initial PV was 1.6meq/kg. The PV of dakuwa increased with storage time but later decreased after the fourth and fifth month of storage for samples packaged in LDP and HDP respectively. Dakuwa in LDP attained a peak

PV of 11.1meq/kg after four months and dropped to 9.6meq/kg after six months while the sample packaged in HDP attained a peak PV of 10.9meq/kg after five months and dropped to 10.1meq/kg after six months. However, the PV of the samples in LDP and HDP at the end of storage were significantly ($p<0.05$) lower than those of the unpackaged sample. Although the PV of the sample in LDP was lower than the PV of the sample in HDP at the end of the storage period, the difference was not significant. The formation of peroxides in dakuwa during storage could be due to the presence of unsaturated fatty acids in dakuwa.. The initial period of slow rate of formation of peroxides represents the initiation/induction phase while the period of fast rate of peroxide formation represents the propagation phase. During the last phase which is the termination phase, free radicals associate to form a wide variety of stable, non-radical, volatile end products such as aldehydes, ketones, alcohols etc. which are responsible for the rancid smell which accompanies fats and oils oxidation (Belitz et al., 2009). The pattern of peroxide evolution was typical of oxidation whereby, after the induction/initiation phase, an initial high rate of oxidation was followed by a slower rate. The PV of the unpackaged sample and the sample packaged in LDP exceeded the acceptable level of 10meq/kg for foods containing fat (AOAC, 2000) after three months of storage while the sample in HDP exceeded the acceptable level after four months of storage with peroxide values of 10.3meq, 10.1meq and 10.6 meq respectively. The difference observed in the rates of PV change among the samples may be due differences in the permeability of the packaging materials. Given that HDP has a lower permeability than LDP, the rate of oxygen uptake will be lower resulting in a lower rate of oxidation in the HDP sample. Hence, the highest rate observed in the unpackaged sample

3.2 pH

The pH values of dakuwa during ambient storage are shown in Figure 2.

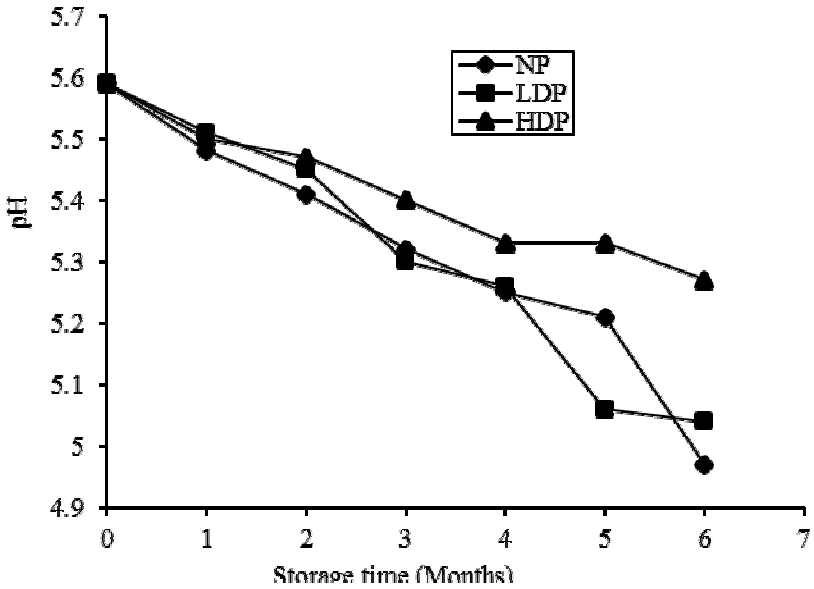

Figure 2: pH of dakuwa under storage

The pH values decreased with storage time. The initial pH of the samples was 5.59. At the end of storage, the pH values were 5.08, 5.05 and 4.97 for sample in HDP, LDP and unpackaged sample respectively. At the end of storage, the pH of the unpackaged sample was significantly ($p<0.05$) lower than the pH of the packaged samples. There was no significant difference in the pH of the packaged samples at the end of the storage period. The decrease in pH values observed through the period of storage may be due to the activities of microorganisms. It could also be due to an increase in the hydrogen ion (H^+) concentration. Rustom et al. (1995) attributed the drop in pH of stored peanut beverage to protein-protein interaction leading to release of hydrogen ion. The drop in pH, with respect to keeping quality, will be an advantage as it could limit microbial activity thereby extending

the shelf life of the product. Conversely, it may cause the product to taste very sour thereby making it unacceptable to consumers. The different rates of pH decrease in the samples may be due to differences in the permeability of the packaging materials.

3.3 Sensory properties

The mean scores for sensory properties of the samples are shown in figures 3-6.

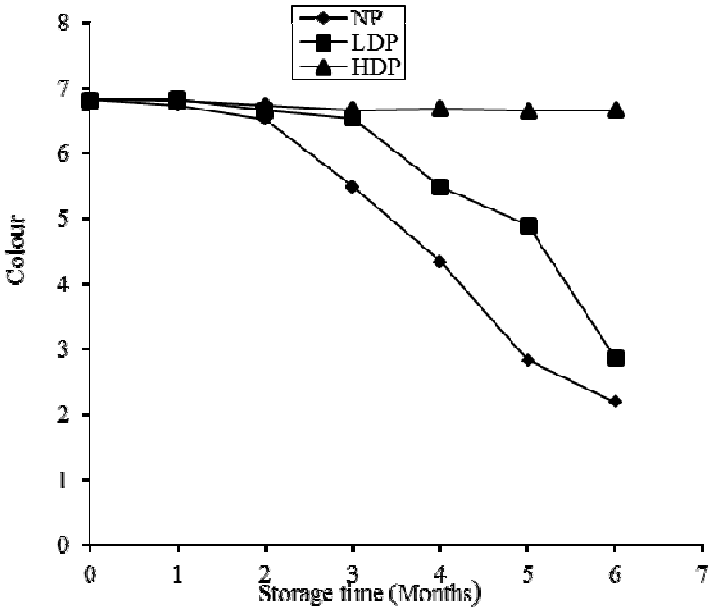

Figure 3: Sensory scores for colour of *dakuwa* under storage

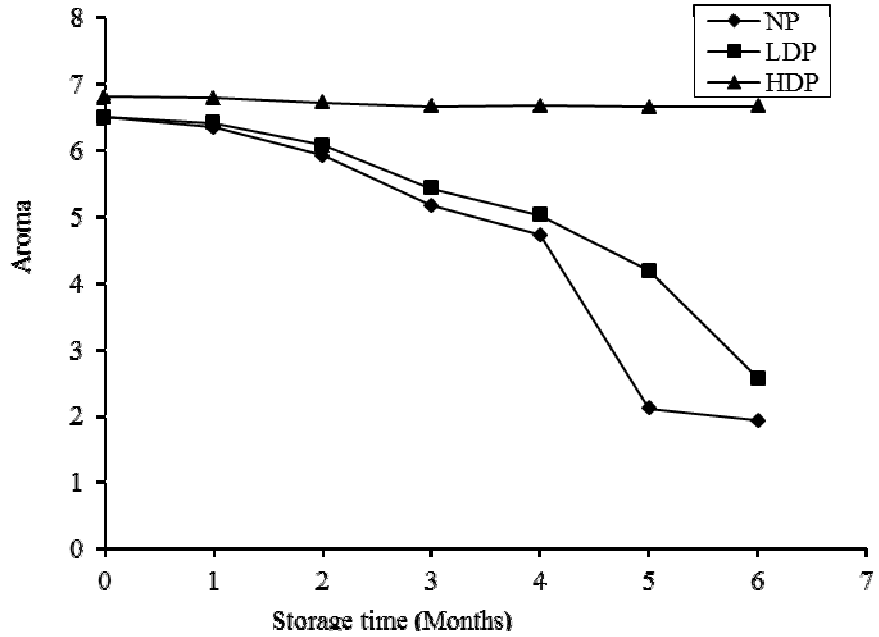

Figure 4: Sensory scores for aroma of *dakuwa* under storage

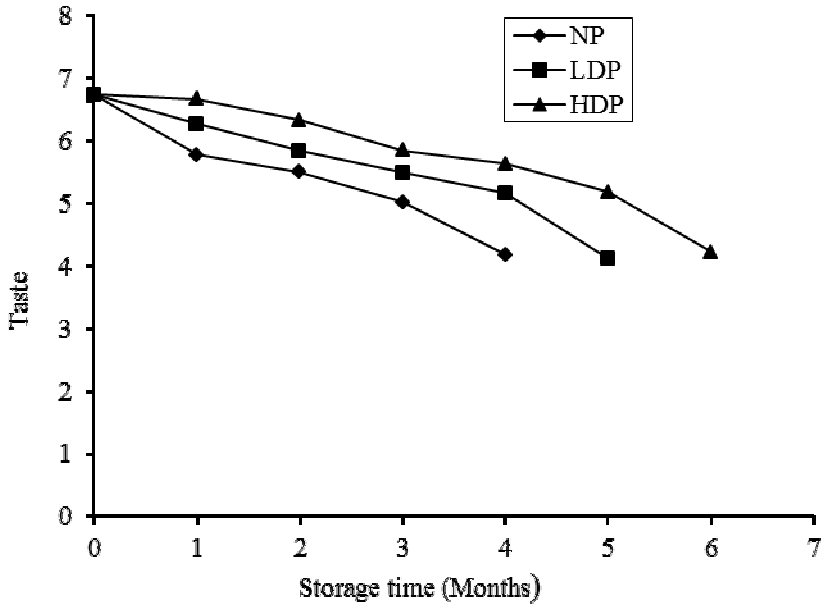

Figure 5: Sensory scores for taste of *dakuwa* under storage

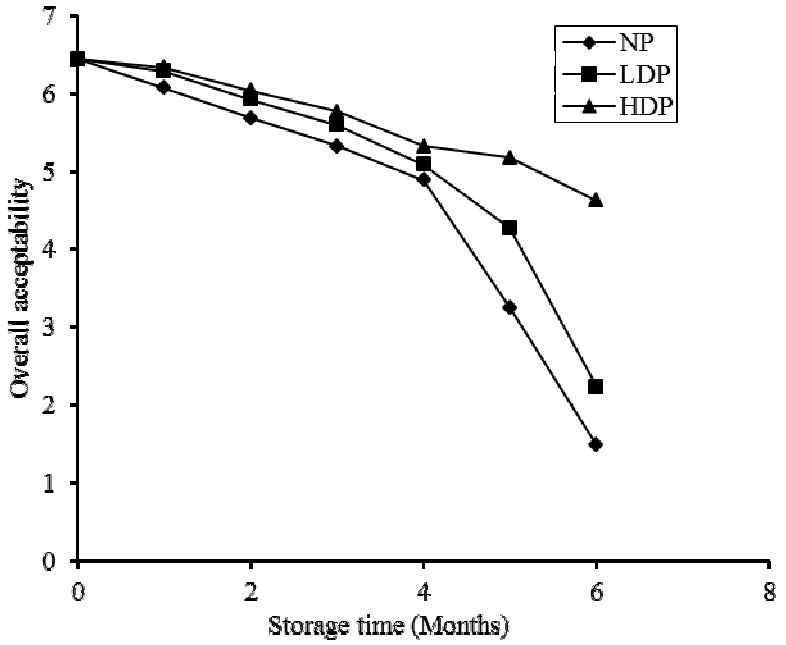

Figure 6: Sensory scores for overall acceptability of *dakuwa* under storage

All sensory attributes decreased throughout the period of storage except for colour which remained stable. After four months of storage, the unpackaged sample became mouldy and developed an unpleasant smell. After five months, the sample in LDP also became mouldy with an unpleasant smell. This caused sensory evaluation for taste to be terminated after four and five months respectively for unpackaged sample and sample packaged in LDP. Although dakuwa samples packaged in HDP did not become mouldy, its score for aroma, taste and overall acceptability after six months fell below the minimum. The stability observed in the colour of the product in HDP all through the period of storage may be indicative of absence of or negligible browning reactions during storage. This may be due to its higher barrier properties compared with that of LDP. The progressive decrease in the mean sensory scores of aroma, taste and overall acceptability of the product may be due to the lowering of the pH which would have caused the product to taste sour. It may also be due to accumulation of peroxides

which subsequently led to the formation of products such as aldehydes, ketones, lactones and alcohols during the termination phase of lipid oxidation. Vidal-Quintanar et al. (2001 and 2003) reported that these products changed the sensory characteristics of corn masa. This implies that the longer the storage period, the further the sensory attributes will deteriorate.

4. Conclusion

The PV, pH, microbial load and sensory properties of packaged and unpackaged dakuwa was affected by storage time and packaging. The PV, pH and sensory attributes decreased throughout the storage period. With respect to sensory attributes, unpackaged dakuwa was acceptable only up to three months of storage while dakuwa packaged in LDP and HDP were acceptable up to four and five months of storage respectively. However the acceptable level of peroxides in food was exceeded after three months in the unpackaged sample and the sample packaged in LDP while that packaged in HDP was exceeded after four months. Consequently, dakuwa should be packaged in HDP and stored for not more than four months. Further studies should be carried out to identify the microflora of dakuwa

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