PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
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Pakistan Journal of Nutrition 9 (11): 1043-1046, 2010
ISSN 1680-5194

Nutritional and Quality Attributes of Wheat Buns Enriched with the Larvae of *Rhynchophorus phoenicis* F.

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Abstract: The larva of *Rhynchophorus phoenicis* is one of delicacies consumed by the people in Southern Nigeria. Proximate analysis of the Larva found it to be nutritious containing protein, fat, ash and carbohydrate at the following ratios (9.96, 25.72, 1.91 and 1.98% on wet basis respectively). A process was developed for incorporating the larva into processed wheat buns. The process involved substitution of wheat flour with the flour of the larva at 5% 10% and 15%. Results of the nutritional analysis of the buns showed increase in the protein, energy, Ca, Mg, Zn and Vitamins content with progressive increase in the larva content. The sensory evaluation showed that no significant difference ($p<0.05$) were observed between the 0% and 5% substitution level in the sensory attributes of aroma and flavor, taste texture and general acceptability. However differences were significant in the colour ($p<0.05$). The buns with 20% larva content was the least accepted in nearly all the quality attributes evaluated. The result shows that an acceptable buns product can be processed with the inclusion of the larva at 5% level to enhance the nutritional quality of the product.

Key words: *Rhynchophorus phoenicis*, proximate analysis, wheat buns, nutritional quality, sensory evaluation

INTRODUCTION

Insects have played an important part in the history of human nutrition in Africa, Asia and Latin America (Bodenheimer, 1951). Hundreds of species have been used as human food. Some of the more important groups include grass-hoppers, caterpillars, beetle grubs and (sometimes) adults, winged termites (some of which are very large in the tropics), bee, wasp and ant brood (larvae and pupae) as well as winged ants, cicadas and a variety of aquatic insects. Ordinarily, insects are not used as emergency food during shortages, but are included as a planned part of the diet throughout the year or when seasonally available. One of such insects popularly consumed in Nigeria is the larvae of the beetle *Rhynchophorus phoenicis F*. It is commonly consumed raw, fried, smoked, roasted and it may be eaten as part of a meal or as a whole meal. Moreover, the nutritional value of this larva has been evaluated (Ekpo and Onigbinde 2005; Okaraonye and Ikewuchi 2008; Banjo *et al*., 2006) and found to be highly nutritious with high quality of macro protein and micronutrients (minerals and vitamins). Thus its addition in diet has been greatly encouraged as a means of combating the problem of malnutrition.

Consequently, the objective of this work aimed at incorporating the larvae flour into common snack-buns made from wheat flour by substituting it (wheat flour) with the larvae at different levels and evaluating the nutritional and sensory qualities of the wheat-larvae buns product.

MATERIALS AND METHODS

Live larvae of Rhynchophorus *phoenicis* were purchased from Ogbe-Ijoh waterside market at Warri South Local Government area of Delta State. The live sample along with their feed were transported to the laboratory in a well ventilated container for analysis at the Nigeria Institute for Oil Palm Research (NIFOR) Benin City, Nigeria and used within ten hours of collection.

Proximate analysis: The larvae were analyzed chemically according to the Official Methods of Analysis (AOAC, 1990). Determinations were performed for water content, crude fiber (structural carbohydrates), fats, protein and mineral salts.

Wheat-based larva buns making process: The processes involved in the manufacture of the buns are shown in Fig. 1. Four blends of wheat and larva flour for the production of wheat buns, were prepared by mixing the wheat flour with the flour from the larva at the following levels 0%, 5%, 10%, 15%. The buns were processed by deep frying in oil at a temperature of 150°C for 12 min.

Nutritional analysis of processed buns: The processed wheat buns were analyzed for the energy, protein, Ca, Mg and Zn contents. The Minerals were analyzed using an Atomic absorption spectrophotometer (AAS, Model SP9, Pychicham UK) the protein content with the Kjedahl method (AOAC, 1990) and the energy content was measured with the use of the Gallenkamp Ballistic Bomb calorimeter (AOAC, 1990). The Vitamin contents were determined using the procedure of (AOAC, 2005).

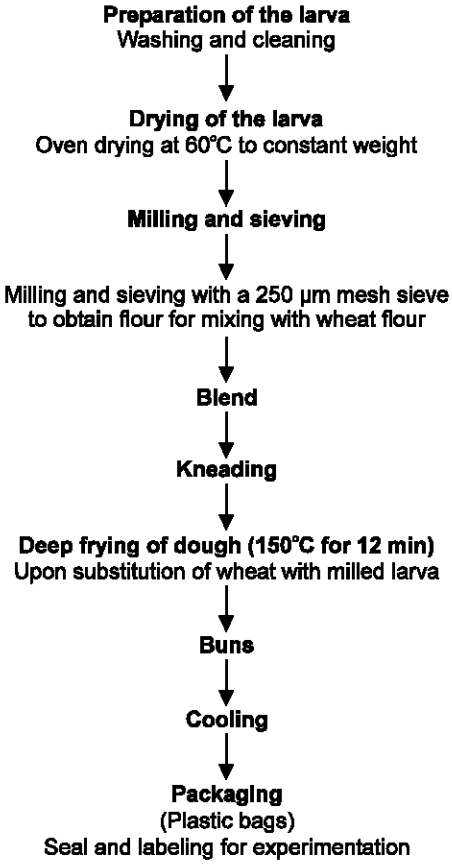

Fig. 1: Flow chart for the production of wheat-based larva enriched buns

Sensory evaluation: The sensory attributes, including colour, texture, aroma/flavour, taste and overall acceptability, were evaluated by a semi trained 20-member panel, using a 7-point Hedonic scale with 1 representing the least score (dislike extremely) and 7 the highest score (like extremely). Analysis of Variance (ANOVA) was performed on the data gathered to determine differences, while the least significant test was used to detect significant differences among the means (Ihekoronye and Ngoddy, 1985).

RESULTS AND DISCUSSION

The results of the proximate analysis are presented in Table 1.

The moisture content is quite high (60.43%), similar result was reported by (Ekpo and Onigbinde, 2005) where a moisture content of 61.5% was reported. The moisture content is an index of water activity (Olutiola *et al*., 1991) and is used as a measure of stability and susceptibility to microbial contamination (Uraih and Izuagbe, 1990). Consequently, the shelf life of the larvae can be improved upon by further processing methods such as drying, frying and roasting. The fat value of

Table 1: Proximate composition of the larvae of *Rhynchophorus phoenicis*

Nutrient	Wet weight (%)	Dry weight (%)
Moisture	60.43	-
Fat	25.72	65.00
Protein (Nx6.25)	9.96	25.16
Ash	1.91	4.82
Carbohydrate (caluted by difference)	1.98	5.02

Result represents the mean of the three determinations

(25.72%) on wet basis increased to (65.0%) on dry basis. Ekpo and Onigbinde (2005) reported a value of 66.1% on dry basis, while Banjo *et al*. (2006) reported a value of 31.4% for the larvae. Furthermore, the crude protein value of 21.56% on dry basis reported in this work shows that the larvae is a rich source of protein and this implies that its use in the diet of human can be exploited to meet the daily requirements of protein intake which is about 23-56 g (FAO/WHO/UNU, 1991; Chaney 2006). A relatively high value of 4.82% ash (dry basis) is observed when compared to other reported values of meat, meat products and egg (Watt and Merril, 1963). Similar values were obtained by Ekpo and Onigbinde (2005) and Okaraonye and Ikewuchi (2008) who reported ash contents of 5.73% and 4.71% dry basis, respectively.

Nutritional composition: the nutritional content of the wheat-larva buns and the results are presented in Table 2.

The protein content was observed to increase progressively in proportion to the percentage of larvae flour added. The larvae of *Rhychophorus Phoenicis* have been reported (Ande, 1991; Fasoranti, 1997) to be a rich source of digestible proteins able to make up for the dietary imbalance as they form real sources of food for man and other animals. Furthermore, of particular interest is the high level of leucine, lysine and threoenine reported by Ekpo and Onigbinde (2005) to be present in the insect larva. Lysine and threonine are limiting amino acids in wheat, rice, cassava and maize based diets prevalent in the developing world (Hill, 1970; Ozimek *et al*., 1985). Therefore, the inclusion of the larva into these staples would enhance the nutritional quality in these diets. The magnesium, zinc and calcium content were also noted to assume the same trend as the protein content with the highest values observed for the 15% larva flour substitution. Zinc deficiency has been known to cause poor growth and impairment of sexual development (Chaney, 1997). In addition, magnesium is needed for more than 300 biochemical reactions in the body. It helps maintain normal muscle and nerve function, keeps heart rhythm steady, supports a healthy immune blood and regulates blood sugar levels (Saris *et al*., 2000). Results of mineral content of the larvae of

Table 2: The nutritional content of the wheat-based larva buns

Rhychophorus phoenics larva content (%)	Nutrient parameter							
	Crude protein (%)	Energy (Kcal/kg)	Mg	Ca	Zn	Vit A	Vit B	Vit C
			(mg/100 g)					
0	14.7	1024	1.12	112.4	0.57	10.30	0.03	7.45
5	17.7	1130	1.48	125.6	1.07	10.63	0.04	8.75
10	19.2	1268	1.62	142.6	1.10	11.63	0.05	9.75
15	21.6	1574	2.75	152.7	1.60	12.75	0.07	10.25

Rhynchophorus Phoenicis reported by (Ekpo and Onigbinde, 2005) showed that consumption of 100 g of the larva would meet the RDA value for iron, zinc, copper, magnesium and manganese in most third world countries. Furthermore, the high content of iron and zinc in many edible insects is of particular interest. Iron deficiency is a major problem in women's diets in the developing world, particularly among pregnant women and especially in Africa (Orr, 1986). The energy content also increased in proportion to the level of larva flour added. Malnutrition in developing countries is as much or more a problem of calorie deficiency as of protein deficiency (Defoliat, 1992). Protein Energy Malnutrition (PEM) contributes to more than 50% of the deaths of children under five years all over the developing countries. The fat level presented in Table 1 implies that a 100 g sample of the larva will meet the calorific needs in most developing countries (Davidson *et al*., 1973). Similarly, there were increases recorded in the Vitamin contents with increasing larva content in the wheat-based larva buns. *Rhynchophorus phoenicis* has been reported to be a rich source of vitamins, particularly thiamin and riboflavin (DeFoliart, 1992). In each case, 100 g of these insects providing more than the minimum daily requirement.

The mean sensory scores for the wheat-based larva substituted buns and whole wheat buns are presented in Table 3.

The Analysis of Variance (ANOVA) showed that the control (0%) did not differ significantly ($p \geq 0.05$) from the 5% larva substituted buns in the sensory attributes except in colour where there was significant difference ($p \leq 0.05$) probably due to Maillard reaction which occurred during the frying process. Hence larva flour substitution at 5% in wheat-based buns was adequate for the product that would enjoy general consumer acceptance comparable to the traditional whole wheat buns. However at higher larva flour supplementation varying significant differences occurs in comparison with the control at the same probability level. The buns with 15% larva substitution had the least scores in nearly all the quality attributes evaluated and it was generally unacceptable by the consumer despite, its nutritional advantage when compared to the other buns samples. Consequently, public enlightenment is needed on the nutritional benefits of supplementation of flour with the larva of Rhynchophorus *Phoenicis* in the production of wheat based buns.

Table 3: Mean score for hedonic sensory attributes of samples

Attributes	Level of larva flour addition			
	0%	5%	10%	15%
Colour	6.1^{a}	5.3^{a}	2.9^{b}	3.0^{b}
Texture	5.15^{a}	4.9^{a}	3.4^{b}	2.7^{b}
Aroma and flavour	5.85^{a}	5.05^{ab}	4.2^{bc}	3.95^{c}
Taste	6.05^{a}	5.25^{a}	3.65^{b}	3.25^{b}
Overall acceptability	6.35^{a}	5.4^{a}	3.6^{b}	3.5^{b}

Scale: 7-point hedonic where, 1 = Dislike extremely 7 = Like extremely. Mean scores in rows with same letters are not significantly different ($p \geq 0.05$)

Conclusion: Buns produced with larva flour substitution, up to 15% were found to be nutritionally superior to that of the whole wheat buns. It has also been found that buns baked with 5% composite flour were not significantly different in most sensory attributes from the control. It is recommended that up to 5% larva flour could be adopted in buns making processes, without affecting quality adversely. The product has the potential of addressing the problems of malnutrition and food insecurity plaguing the least developed countries.

REFERENCES

Ande, A.T., 1991. Some aspects of the Biology of Insects (Lepidoptra: Saturnidae, Coleoptera: curculionidae). Nig. J. Entom., 24: 106-129.

AOAC, 1990. Methods of the Association of Official Chemists. Official Methods of Analysis, 15th Edn., Virginia Assoc. Official Analytical Chemists, USA., pp: 1141.

AOAC, 2005. Official Methods of Analysis of the Association of Official Analytical Chemists, 17th Edn., AOAC, Gaitherburg MD., USA.

Banjo, A.D., O.A. Lawal and E.A. Songonuga, 2006. The nutritional value of fourteen species of edible insects in Southwestern Nigeria. Afr. J. Biotechnol., 5: 298-301.

Bodenheimer, F.S., 1951. Insects as Human Food, W. Junk, The Hague, pp: 352.

Chaney, S.G., 1997. Principles of Nutrition II. Macronutrients. In: Textbook of Biochemistry with clinical correlations. (T.M. Devlin, Ed). Wiley-Liss Inc., New York, USA., pp: 1108-1136.

Chaney, S.G., 2006. Principles of Nutrition II Micronutrients. In: Textbook of Biochemistry with Clinical Correlation, Delvin, T.M. (Ed). John Wiley and Sons, New York, pp: 1091-1120.

Davidson, S., R. Pasmore and J.F. Brock, 1973. In: Human Nutrition and Dietetics (5th Edn.). The English language book society and Churchill Livingstone, pp: 77.

DeFoliart, G., 1992. Insects as human food. Elsevier Science (publishers), pp: 295-399

Ekpo, K.E. and A.O. Onigbinde, 2005. Nutritional Potentials of the larva of *Rhynchophorus phoenicis* (F). Pak. J. Nutr., 4: 287-290.

FAO/WHO/UNU, 1991. Energy and Protein requirements: Report of a Joint FAO/WHO/UNU Expert consultation. WHO Technical Report Series 724. http: //www.fao.org/docrep/003/aa040e/AA040 E01.htm.

Fasoranti, J.O., 1997. The value of African insects as human food supplements. J. Sci. Tech., 10: 1-5.

Hill, M.M., 1970. Food Guides-Their Development and Use. Nut. Prog. News (US Department of Agriculture). Washington DC., pp: 1-5.

Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated food Science and Technol. for the tropics. 1st Edn., McMillan publishers, pp: 185-190.

Okaraonye, C.C. and J.C. Ikewuchi, 2008. *Rhynchophorus phoenicis* (F) larva meat: Nutritional value and health implications. J. Bio. Sci., pp: 1-5.

Olutiola, P.O., O. Famurewa and H.G. Sonntag, 1991. An Introduction to General Microbiology, A Practical Approach. 1st Edn., Heidelberger Verlagsanstalt and Druckerei GmbH Heidelberg, Germany, ISBN: 3-894-042-4.

Orr, B., 1986. Improvement of women's health linked to reducing widespread anemia. Int. Health News, 7: 3.

Ozimek, L., W.C. Sauer, V. Kozikowski, J.K. Ryan, H. Jorgensen and P. Jelen, 1985. Nutritive value of protein extracted from honey bees. J. Food Sci., 50: 1327-1332.

Saris, N.E., E. Mervaala, H. Karppanen, J.A. Khawaja and A. Lewenstam, 2000. Magnesium: An update on physiological, clinical and analytical aspects. Clinica Chimica Acta, 294: 1-26.

Uraih, N. and Y. Izuagbe, 1990. Public Health, Food and Industrial Microbiology. 1st Edn., Uniben Press: Nigeria, ISBN: 978-2027-00-6.

Watt, B.K. and A.L. Merril, 1963. Consumption of food: Raw, processed and prepared. U.S. Dept. Agric. Handbook, 8: 1-189.