

## NUTRIENT AND ENERGY CONTENT OF QUALITY PROTEIN MAIZE MEAL WITH GRADED SUPPLEMENTATION OF ANCHOVIES FISH

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### ABSTRACT

To provide guidelines for consumers and dieticians, Quality Protein Maize (QPM) meal and Anchovies fish were analyzed for nutrient and energy content, separately, and in varying supplementation mixtures. QPM meal (Banku) was prepared by traditional procedure, subsequently oven dried and milled to facilitate determination of proximate composition, using Association of Analytical Chemists (A.O.A.C.) methods per 100g of dry matter. Carbohydrate content was determined by difference. Similar analysis was performed on Anchovies fish alone, and as 5%, 10%, 15%, 20%, and 25% supplements of the QPM Banku. Anchovies fish had the same content of moisture, threefold protein, fourfold fat, one-third crude fiber, fourfold ash, and one-eighth the energy content of unsupplemented QPM Banku. Supplementation of QPM Banku with 5% Anchovies fish increased protein content per 100g from 28.0g to 30.2g, fat from 1.0g to 1.4g, ash from 2.5g to 3.0g, energy from 325.0kcal to 327.5kcal, and decreased crude fiber from 2.4g to 1.8g, and carbohydrate from 59.6g to 57.8g. Nutrient content of QPM Banku did not vary for 5% and 10% Anchovies supplementation, but there was a decrease in energy to 324.4kcal. There was also a gradual increase in nutrients from 15% to 25% supplementation. Energy content, however, decreased from 327.5kcal to 315.4kcal, and carbohydrate from 57.8g to 47.6g per 100g with increase in level of supplementation from 5% to 25%. On the basis of the daily dietary protein and energy requirements for pre-school children, 5% supplementation of QPM Banku with Anchovies fish was found to be adequate.

### INTRODUCTION

Maize, in various processed forms, is an important staple food for large numbers of people in the developing world, making a significant contribution in their caloric and protein intakes (FAO, 1992). Traditional maize varieties are, however, deficient in lysine, tryptophan and the B-vitamins (Mertz, 1994). In order to improve the nutritive value of maize, meals prepared from it may be consumed with supplements such as soybeans, green leafy vegetables, cowpea, and fish.

A further attempt at improving the nutritive value of maize has led to the development of Quality Protein Maize (QPM) in Ghana, since 1992 (Twumasi-Afriyie et al., 1992). QPM, known locally as *Obatanpa*, literally translated, as "Good Mother" is a high-lysine, high-tryptophan variety derived from Opaque-2-maize (Abenkora, 1993).

QPM varieties and their hybrids are increasingly becoming popular in Latin America and Ghana (Twumasi-Afriyie et al., 1992). In Ghana, as in other African countries, the preparation of maize meals involves various processing methods, such as soaking, sprouting, fermentation, and cooking (Abenkora, 1993), some of which may further improve the nutrient profile of the meal. Despite the improved nutritional value of QPM, and the possible improvement by the processing method, the practice of consuming it with other protein supplements will still go on, since acceptability of the meal prepared from it is as important to the consumer as the nutritional value. Among the Akans in Ghana for instance, there is the belief that consumption of any meal without animal protein will lead to deafness. For these reasons, even financially constrained families would try to supplement the QPM meal with some fish. In Ghana,

the most common, cheaper and widely consumed fish variety is *Anchovies*, which may be taken in dried or smoked forms. It is therefore relevant to ascertain the protein content of *Anchovies*, and what level of supplementation would really be necessary so far as the energy and protein needs of consumers are concerned.

The present work therefore provides information on the proximate composition of *Anchovies Banku* (a dumpling) prepared from Quality Protein Maize, and portions supplemented with graded amounts of *Anchovies*, to provide a useful guideline on the amounts of energy, protein and other nutrients that can be made available, to its consumers, especially children from financially constrained families.

### MATERIAL AND METHODS

**Maize Varieties:** The QPM (*Obatanpa*) variety was obtained from the Crops Research Institute at *Fumesua*, Kumasi, Ghana. Samples were taken from three randomly selected bags, and tests were carried out at the *Nosakawa* Laboratory at Crops Research Institute, *Fumesua*, to confirm the veracity of the variety, using their levels of lysine and tryptophan.

**Formulation of the Diets:** In the Preparation of the QPM meal (*Banku*), a reasonable quantity of QPM, depending on the storage facilities available was steeped in clean water for three days, after thoroughly washing the grains. On the third day, the maize was washed, drained of excess water and milled wet. Approximately 1 kg of the flour was mixed with 1 liter of clean water, and kneaded. The resulting mixture was left to stay overnight, to produce a fermented product, known as corn dough. *Banku* was prepared by mixing about 3.0 kg of dough with 2.0 liters of water and approximately 60.0 g of iodized table salt, and cooked with constant stirring, and stretching with a carved piece of wood. The preparation process of the *Banku* was carried out with intermittent addition of water, depending on the mixture and viscosity desired, until semi-solid dough was formed. The *Banku* so prepared was broken down into smaller bits under very hygienic conditions, spread on clean metal trays and dried in a hot air drier at 105.0 °C for 24 hours. The resulting dried *Banku* was then milled to obtain the dry matter ready for

supplementation with the dried fish (*Anchovies*) powder.

**Fish:** Heat smoked and dried *Anchovies* were obtained from the open market in Accra, Ghana. The head and the scales of the fishes were removed. They were then milled into powder, and stored in a cold room.

Six different diet mixes were prepared from the dried, milled QPM *Banku* and the fish (*Anchovies*) powder, using graded portions of the fish as: 0%, 5%, 10%, 15%, 20%, 25%, by weight.

**Proximate Composition Analysis:** Moisture, Protein, fat, crude fibre, ash and carbohydrate contents of the *Anchovies*, QPM *Banku* with and without supplementation with *Anchovies* were determined on dry matter basis in duplicate according to the methods of Association of Analytical Chemists (A. O. A. C., 1990), in the laboratory of the Department of Nutrition and Food Science, University of Ghana, Legon, while energy content was determined by the ATWATER SYSTEM (FAO, 1982).

### RESULTS AND DISCUSSION

Table 1.0 shows the proximate composition of *Anchovies*, QPM *Banku*, and *Anchovies* supplemented mixes of the QPM *Banku*

With a percentage protein of 72.2% on dry matter basis, *Anchovies* is a very good source of fish, a food item that features prominently in the diet of most populations. It provides the source of animal proteins for most of the rural or urban poor who may not be able to afford the relatively more expensive meat and poultry products. Furthermore, due to its soft nature and easy digestibility fish is a very important source of protein for children in most developing countries. In these populations fish is also eaten together with starchy staples or cereals or grains; therefore *Anchovies* will be very useful.

*Anchovies* is a specie of marine fish. In Ghana it is processed and consumed in various forms: fresh, smoked-dried, or sun-dried. It is the cheapest of all the marine fishes available on the market, and is therefore very important for a greater proportion of the rural and urban poor that use it frequently.

**Table 1.0 Proximate Composition of Anchovies, QPM *Banku* and graded Anchovies supplemented mixes, per 100g on dry matter basis.**

Sample	% Moisture	% Dry matter	% Protein	% Fat	% Crude Fibre	% Ash	% CHO*	Energy (Kcal)
Anch	6.5	93.5	72.2	4.1	0.8	9.3	7.2	260.1
QPMB	6.5	93.5	28.0	1.0	2.4	2.5	59.6	325.0
QPMB + 5%Anch	5.7	94.3	30.2	1.4	1.8	3.0	57.8	327.5
QPMB + 10%Anch	5.7	94.3	32.4	1.4	1.9	3.0	55.6	324.4
QPMB + 15%Anch	5.8	94.2	34.6	1.6	1.7	3.8	52.5	319.5
QPMB + 20%Anch	5.7	94.3	36.8	1.9	1.7	3.8	50.2	318.2
QPMB + 25%Anch	5.5	94.5	39.0	2.1	1.4	4.5	47.6	315.4

Key: Anch = *Anchovies*; QPMB = QPM *Banku*;  
CHO\* Carbohydrate obtained by difference

The higher percentage of Protein, Fat, and Ash in the *Anchovies* as compared to the QPM *Banku* is expected since the *Anchovies*, which is fish, is obviously a better source of protein, fats and oils, as well as minerals. Apart from the Ash content, which was lower, the protein, fat and ash contents of *Anchovies* as found in this study, compares favourably well with the respective values of 68.6g, 3.5g and 16.0g per 100g reported by Eyeson and Ankrah (Eyeson and Ankrah, 1975). These findings give a clear indication that smoked dried *Anchovies* are a very good source of protein, and can be used as a food supplement to improve the protein quality of diets which are limiting in essential amino acids, especially, maize.

The percentages of the components of the QPM *Banku* meal are also quite high when compared with 7.2g of protein, 0.2g of fat, 0.1g of fiber and 2.0g of Ash, per 100g of normal maize, reported by Eyeson and Ankrah (Eyeson and Ankrah, 1975). However, concentration effect, since hot-air-oven dried sample of the QPM *Banku* was used in this study, cannot be discounted.

The dry matter in the analyzed sample was 93.5%, whereas in the freshly prepared QPM *Banku*, it was 35.0%. This implies that in the QPM *Banku*, the Protein, Carbohydrate, Fat and Ash contents

are expected to be almost a third of that of the dried QPM *Banku*, that is, 10.5g, 22.3g, 0.4g, and 3.5g, per 100g, respectively. These figures are consistent with the findings of Abenkora *et al.*, (1995), and Oracca-Tetteh (1985). These figures suggest that a pre-school child, the most vulnerable in respect of dietary energy and nutrient supplies, who may consume a daily average of 500.0g of QPM *Banku* with 5.0% *Anchovies* will obtain approximately 52.9g of protein and 572.3 kcal of energy, while the meal with 10.0% *Anchovies* will provide respective values of 56.7g and 567.7 kcal. The results of the study suggest that with increase in the percentage supplementation, though the protein intake may increase, the energy intake may decrease. Nevertheless, with QPM *Banku*, 5.0% *Anchovies* supplementation can provide the required daily protein intake of the pre-school child, (16.0g – 24.0g), (Garrow and James, 1993), and also make the highest contribution of energy intake.

Table 1.0 further shows that while protein, ash and fat contents of the various supplemented *Banku* mixes increased with increase in the proportion of *Anchovies*, the crude fibre and carbohydrate contents rather decreased. This observation is the consequence of increase in the amount of proteins, fat and ash from the *Anchovies* as its proportion increases. On the basis of the assertion by Fox and Cameron (1995), that the quality of a protein food

is judged by its protein content the QPM *Banku* diet with *Anchovies* can be said to have a high quality protein. This is confirmed by the relatively higher levels of lysine and tryptophan found in this maize variety (Bressani, 1991; Twumasi-Afriyie et al., 1994; Ahenkora et al., 1999).

On the basis of the statement by Latham (1997) that the only sustainable way to improve the nutritional status in developing countries is to adopt food-based approach, the important role QPM can play in managing or preventing Protein-Energy-Malnutrition cannot be overemphasized. In Ghana, where Armar-Klemesu *et al.* (1995) have attributed the myriad of nutritional problems to poor quality of diet, among other things, and severe nutritional deficiencies in protein and calories have also been reported in a greater part of the country (GoG and UNICEF, 1990; GDHS, 1998), the promotion of the cultivation and use of QPM will be worthwhile. The fact that the acceptability of the QPM variety for the various forms of traditional maize meals in Ghana is already established (Ahenkora et al., 1999) implies that the promotion of its widespread use in the nation may require little effort. On the basis of the significant contribution maize makes in the daily supply of calories and proteins to individuals in certain developing countries (FAO, 1992) there is no doubt that the promotion of the cultivation and use of QPM maize would go a long way in solving the problem of Protein-Energy Malnutrition. This is because as much as over 30.0% of the daily protein requirement and 40.0% of the caloric requirements can be provided by QPM.

## CONCLUSION

*Anchovies* has a high protein content (72.2g per 100g dry matter), and for that matter a very good source of animal protein supplement for the majority of people among whom it is popular. On the basis of the dietary protein and caloric requirement of a pre-school child, the most vulnerable in respect of these supplies, 5.0% supplementation with *Anchovies* is adequate for a Quality Protein Maize (QPM) *Banku*.

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## References

- Ahenkora K., Utilization and processing of maize. CRI Research Management Training Guide No. 26 Crops Research Institute, Kumasi, Ghana. pp 32 (1993)
- Ahenkora K., S. Twumasi-Afriyie, P. Yao Kanze Sallah, and K. Obeng-Antwi; Protein Nutritional Quality and Consumer acceptability of Tropical Ghana Quality Protein Maize. Food and Nutrition Bulletin Vol. 20 No. 3, Sep. pp.354-360 (1999).
- Ahenkora K.; Twumasi-Afriyie S., W. Haag and B.D. Dzah; Ghanaian Kenkey from Normal and Quality Protein Maize: Comparative Chemical Composition and Rat Growth Trials. Cereal Research Communications Vol. 23 No.3, pp 299 - 304 (1995).
- A.O.A.C., Official Methods of Analysis of the Association of Official Analytical Chemists, Edited by Kenneth Helrich (15<sup>th</sup> Edition). A.O.A.C. Inc. Suite 400, 2200 Wilson Boulevard Arlington, Virginia 22201, U.S.A. pp 69-84 (1990).
- Armar-Klemesu M.; T. Rikimaru; D.O. Kennedy; E. Harrison, Y. Kido, and E.E.K. Takyi; Household food security, food consumption patterns, and quality of children's diet in a Rural Northern Ghana Community. Food and Nutrition Bulletin, Vol. 16, No.1, March (1995).
- Bressani, R.; Protein Quality of high lysine maize for humans. Cereal Foods World: 36:806-811 (1991).
- Eveson K.K.; Ankrach, E.K.; Composition of Foods commonly used in Ghana. Food Research Institute. Council for Scientific and Industrial Research, Accra (1975).
- FAO, Food Composition Tables for the Near East. FAO, Rome (1982).
- FAO (Maize in Human Nutrition, FAO, Rome (1992).
- Fox, B.A., Cameron A.G.; Food Science, Nutrition and Health 6<sup>th</sup> ed. Arnold, London, Sydney, Auckland., pp 170-171 (1995).

- Garrow, J.S.; James, W.P.T.: Human Nutrition and Dietetics 9<sup>th</sup> Ed. Churchill Livingstone. Edinburgh London. New York Tokyo, pp 387-455 (1993).
- GDHS, Ghana Demographic Health Survey, Ghana Statistical Services, and Macro International Inc. Calverton, Maryland USA, pp.113-140 (1998).
- GoG and UNICEF; Children and Women of Ghana. A situation Analysis (1989-1990). Accra pp 71 (1990)
- Latham, M. C. Human Nutrition in the Developing World. FAO Food Nutrition in the Series No. 29, Rome pp. 4,127-146 (1997)
- Mertz, E.T., Thirty years of Opaque - Maize. In: Larkins, B.A., and Mertz E.T., (ed): Quality Protein Maize: 1964-1994. Proceedings of the International Symposium on Quality Protein Maize. EMBRAPA/ECPMS, Sete Lagoas, M.G., Brazil. December 1-3, pp1-9 (1994).
- Oracca-Tetteh R.K (1985): Weaning Foods: Research and its Application. In: F.F.T. Djabonor, and Y. Asirifi (eds), Diarrhoeal and Nutritional Disorders of Early Childhood. Proceedings of the 10<sup>th</sup> Annual scientific Meeting of the West Africa College of Physicians, Accra, pp. 56-58 (1995).
- Twumasi-Afryie, S.; Badu - Appraku, B.; Salla, P.Y.K.; Haag, W.; Aseidu, E.A. Marfo, K.A.; Ohemeng-Dappah, S.; Dzah, B.D.; Development and release of Obatanpa, an intermediate maturing quality protein maize variety in Ghana. Crops Research Institute, Kumasi, Ghana (1992).
- Twumasi-Afryie, S.; Sallah, P.Y.K.; Owusu-Akyaw, M.; Ahenkora, K.; Soza, R.F.; Haag, W.; Dzah, D.B.; Okai, D.B.; Akuamoah-Boateng, A.; Development and Utilization of Quality Protein Maize in Ghana. In: Larkins, B.A, and Mertz, E.T.(eds). Quality Protein Maize 1964-1994. The Proceedings of the International Symposium on Quality Protein maize. EMBRAPA/CNPMS. Sete Lagoas, MG, Brazil, December 1-3, pp. 205-216 (1994).