# THE STABILITY AND NUTRIENT CONTENT OF WHOLE MAIZE-MEAL AND DEGERMED MAIZE-MEAL

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## SUMMARY

Two types of maize-meal:- whole maize-meal and degermed maize-meal were dried to a moisture level of 8.0% (to forestall mould growth), placed in airtight containers and stored at room temperature (27°C) for 3 months.

The Fat Acidity Value of the whole meal was more than double its original value (from 34.72mg KOH/100g to 78.76mg KOH/100g) after two weeks storage, and at this stage taste panel results on cooked samples showed development of off-flavour and bitterness. After 12 weeks storage, the Fat Acidity Value of the wholemeal was 246.43mg KOH/100g. On the other hand, the initial Fat Acidity value of the degermed meal, 12.11mg KOH/100g increased to only 36.28mg KOH/100g after 12 weeks storage and no odours were detected when cooked samples were tasted.

These results showed that development of off-flavours and after-taste due to fat rancidity was much faster in the whole maize-meal than was found in the degermed maize meal.

Analyses for nutrient content showed that thiamine, riboflavin, iron and phosphorus were significantly reduced by degermination whilst the protein content was only slightly reduced.

## INTRODUCTION

In both grain and grain flours, fat acidity is considered very important because it is generally used as a measure of deterioration (Matz. 1959).

Various workers have investigated factors that influence the stability of grains and grain flours on storage, and a relationship was found between fat acidity values and the degree and type of damage to the grain (Baker et al, 1957 and Sorger-Momenigg et al, 1955). Other work in this field showed that whole-wheat flour stored at low moisture content and temperature developed odours faster than patent flour. The stability of flours may be enhanced by increasing the degree of refinement and decreasing moisture content below normal commercial levels (Cuendet et al 1954). By keeping moisture content low, mould growth which contributes significantly to the development of odours, is controlled.

Increasing the degree of refinement in flour ensures elimination of as much of the germ portion of the grain as possible, since it is in the germ that most of the oil is contained. It is therefore necessary to eliminate the fat containing portion because fats may be split up enzymatically by lipase to liberate fatty acids which may impart bitterness to fat containing materials or they may undergo oxidation with the production of unpleasant tallowy taste. Both types of fat deterioration occurs in flours of cereals so milling engineers have designed milling equipment in a way to exclude from white flour as much fat or oil as possible (Kent-Jones and Amos 1967).

Natural nutrients in whole-meal are significantly higher than in degermed meal. This is because these nutrients occur mostly in the germ, aleurone layer and scutellum tissue of the maize kernel which are removed in the dry milling process of degermination (Inglett, 1970).

During the last year, there have been calls from Governmental levels to the Ghanaian bakers to go into production of bread made from composite flour as a means of cutting down importation of wheat and thereby saving foreign exchange. In the manufacture of 'corn bread', maize flour is needed to replace part of wheat flour but there is no mill in Ghana producing maize flour for such purpose. As a result, the few bakers engaged in 'corn bread' manufacture have been using maize meal which is prepared by the individual bakers.

The object of this work was to investigate the effect of storage on the stability of whole maize meal and degermed maize meal using fat acidity values, and a taste panel, as a measure of deterioration.
The effect of degermination on nutrients was also investigated.

## MATERIALS AND METHODS

### Maize Meals

Whole maize-meal and degermed maize-meal samples (3 each) were prepared with an attrition mill from white local maize. The moisture levels of the meals were kept at 8.0% and the samples were stored in airtight containers at room temperature. The proximate composition of the meals is shown in Table I (A.A. C.C. 1962).

### Fat Acidity of Maize-Meals

The fat acidity values (which give indication of fat rancidity of meals) were determined at intervals of one week using A.A.C.C. method 021-01. Analysis of each sample was carried out in duplicate. It is recommended that all samples should be at moisture level not above 10% in order to secure comparable results otherwise hydrolysis at time of fat extraction increases the fat acidity values.

### Taste Panel

At intervals of one week samples were cooked for tasting. 20g of each sample was soaked in 200cc. water for 2 hours. The mixture was cooked with stirring till boiling. It was then boiled for 10mminutes. The cooked samples were then tasted by a panel of 6 to detect any off-flavour and after-taste.

### Thiamine & Riboflavin Contents

The thiamine content was determined by the Thiochrome method (A.A.C.C. 1962). For the determination of riboflavin, the fluorimetric method was used (A.A. C.C. 1962).

A Hilger & Watts Fluorimeter Type H960 was used for both determinations.

Mineral Contents

Calcium was determined by the standard method as described by A.O.A.C. (1970). Phosphorus was determined according to the method as described by Fogg & Wilkinson (1958).

Iron was determined by the method described by A.O.A.C. (1970).

## RESULTS AND DISCUSSION

Table I

PROXIMATE ANALYSIS OF MEALS
(EXPRESSED AS % OF DRY MATTER)

| Constituent | Whole maize meal | Degermed maize meal |
|---|---|---|
| Crude protein % (N x 6.25) | 10.24 | 9.62 |
| Crude Fiber % | 2.90 | 0.45 |
| Ether Extract % | 4.32 | 0.14 |
| Ash % | 1.20 | 0.05 |

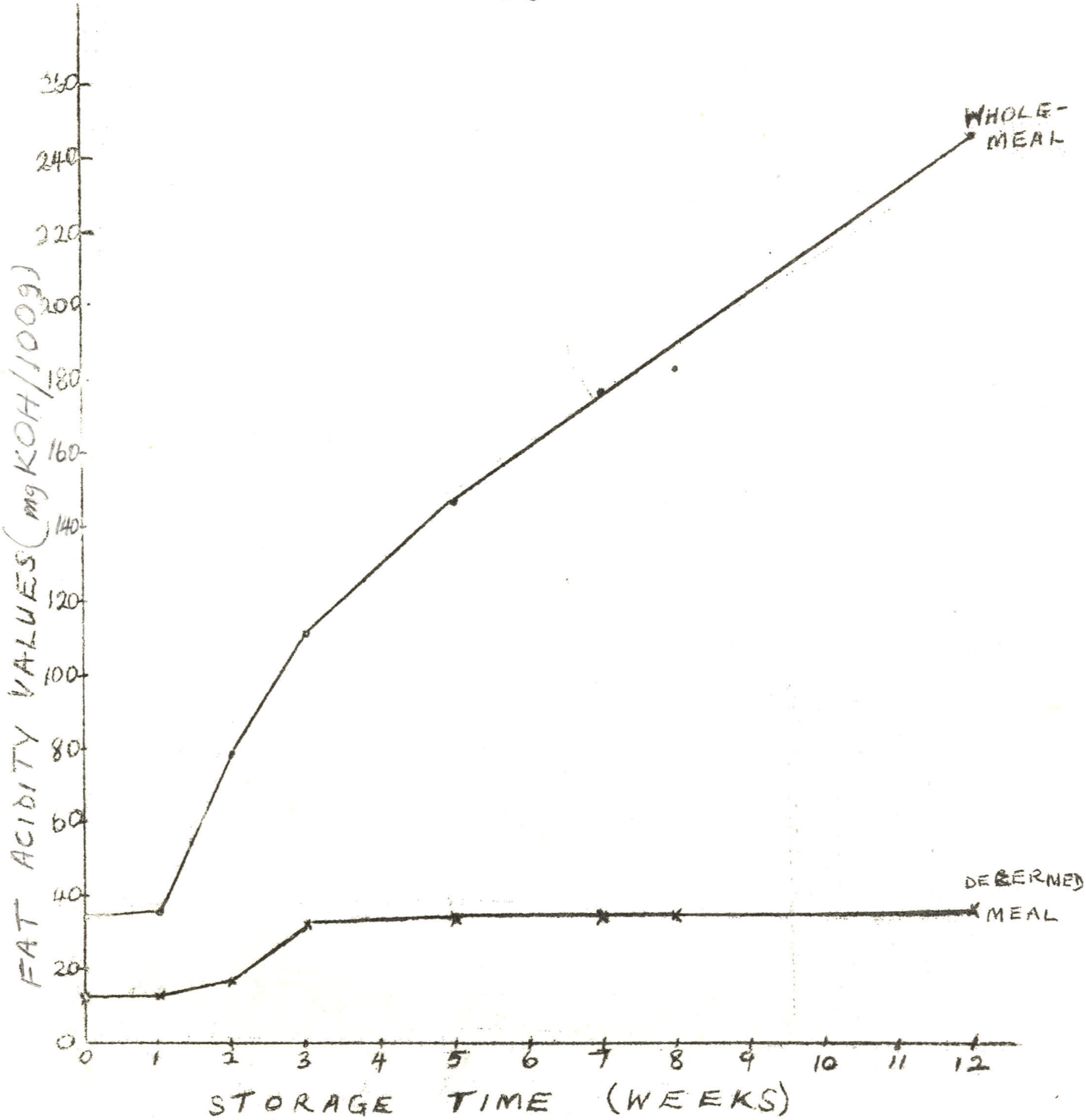


FIG. I: RATE OF FREE FATTY ACID PRODUCTION IN STORED MAIZE MEALS (Dry weight basis)

The initial value of fat acidity for degermed meal was much lower than that for the whole meal as a result of the elimination of maize oil from the grain in the course of degermination. The rate of development of free fatty acids during the storage period was much higher in the whole meal than it was in the degermed meal. This may be due to enzymatic breakdown or oxidation of maize oil in the whole meal or both (Kent-Jones and Amos, 1967).

Taste Panel

Taste Panel results showed that after 2 weeks storage, whole maize-meal developed off-flavour and after-taste whilst the flavour and taste of degermed meal was acceptable up to 12 weeks storage. Even though there was some increase in level of free fatty acids in degermed maize-meal, it was not high enough to be detected by taste panel.

Table II

VITAMIN AND MINERAL CONTENT OF MEALS
DRY WEIGHT BASIS

| Nutrient | Whole maize-meal | Degermed maize-meal |
|---|---|---|
| Thiamine ug/gm | 4.36 | 0.21 |
| Riboflavin ug/gm | 0.44 | Nil |
| Iron mg/100g | 30.3 | 18.4 |
| Ca mg/100g | 190.0 | 150.0 |
| P mg/100g | 540.0 | 50.0 |

Mineral content of whole maize meal showed high levels of iron and calcium.

There was reduction of mineral content after degermination. This is because about 80% of the minerals are in the germ (Earle et al. 1946). The results on Thiamine and Riboflavin content showed that whole maize-meal was initially deficient in riboflavin which was further reduced by degermination. Thiamine which was quite high was drastically reduced by degermination. This is due to the fact that both vitamins are concentrated in the germ part of the maize grain.

## CONCLUSIONS AND RECOMMENDATIONS

Our results showed that whilst degermination prolonged the shelf-life of maize-meal, it also reduced the nutrient content (Fig.I and Table II).

Attempts by other workers to lengthen the shelf-life of whole maize meal by the use of heat or antioxidants have so far been unsuccessful (Inglett, 1970). Degermination therefore, seems to be the most efficient way of prolonging the shelf-life of maize meal.

On the question of nutrient content, it is hoped that on the establishment of a maize flour mill, appropriate enrichment of flour would be carried out.

It is recommended that whole maize meal be used within 7 days of preparation in order to forestall the development of off-flavours.

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REFERENCES

A.A.C.C. (1962) Cereal Laboratory Methods, 7th Edition Minnesota: American Association of Cereal Chemists.

A.O.A.C. (1970) Official Methods of Analysis 11th Edition Washington D.C. Association of Official Analytical Chemists.

Baker, D., Neustadt, M.H. and Zeleny, L. (1957) Application of Fat Acidity Test as Index of Grain Deterioration. Cereal Chem. Vol.34 pp.226-233.

Cuendet, L.S., Larson, E., Norris, C.G. and Geddes, W.F. (1954) The influence of Moisture Content and Other Factors on the Stability of Wheat Flours at 37.8°C. Cereal Chem. Vol.31, pp.362-389.

Earle, F.R., Curtis, J.J. and Hubbard, J.E. (1946) Composition of the Component Parts of the Corn Kernel Cereal Chem. Vol.23 pp.504-511

Fogg, D.N. and Wilkinson, N.T. (1958) The Colorimetric determination of Phosphorus. Analyst Lond. 83, pp.406-414

Inglett, G.E. (1970) Corn: Culture, Processing, Products A.V.1. Publishing Co., Inc. Westport, Connecticut.

Kent-Jones, D.W. and Amos, A.J. (1967) Modern Cereal Chemistry, 6th Edition, Food Trade Press Ltd., London.

Matz, S.A. (1959) The Chemistry and Technology of Cereals as Food and Feed The A.V.1 Publish Co., Inc. Westport, Connecticut.

Sorger-Demenigg, H., Cuendet, L.S. and Geddes, W.F. (1955) Grain Storage Studies XX Relation between Flourescence value and Formazan value of commercial wheat flours. Cereal Chemistry Vol.32, pp.499-509.

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