

MAIZE GERM AND BRAN FOR VALUE ADDITION: HIGH FIBER BAKERY AND CONFECTIONERY PRODUCTS

Prof. Charles Muyanja; Ms. Jolly Gonahasa; Ms. Joan Nabakooza; Byamukama Julius

EXECUTIVE SUMMARY

Maize is a major food crop in developing countries. The milling of maize to make flour results in large amounts of maize bran and germ. The two by-products are of low economic value and dominate the livestock feed manufacturing sector hence not considered as human food.

The creation of awareness on the benefits of maize bran and germ as raw materials and establishing guidelines for their use as human food can revolutionise the maize industry. Careful handling of maize germ and bran by the millers can also result in the creation of vital raw materials for the confectionery and bakery sector.

At the policy level, the Ministry of Health and Uganda National Bureau of Standards can develop implement and enforce standards to enhance the nutrition value of the bakery and confectionery products with fiber by incorporating maize bran and germ. In the long run, this will have a positive impact on the Food and Nutrition Policy.

INTRODUCTION

Like many developing countries, Maize (*Zea mays* L.) is the most important cereal crop grown in Uganda. Statistics from National Household Survey (UNHS) indicated that approximately 86% of the 4.2 million agricultural households were engaged in maize production. The crop is consumed in various forms as a snack (roasted and steamed), porridge or bread (posho). The main processing method used for maize is huller milling, which results in large amounts of germ-bran mixture. The traditional uses of bran and germ are mainly centred around processing animal feeds, which does not fetch high prices. Maize germ-bran can also be used to improve the nutritional content of various confectionery and bakery products when handled as a raw material.

Maize bran is vital in the provision of additional fiber content in different products for human consumption. Fiber promotes good health as it contains various minerals that are vital for the proper function of the body and also prevents constipation.

Maize germ, on the other hand, is highly nutritious with essential oils and proteins that are necessary for the human body. Consumption of food products incorporated with bran and germ has been associated with normalising bowel movements; maintaining bowel health; and lowering blood cholesterol linked to heart problems.

These products are also credited with controlling blood sugars associated with

stimulating obesity thus leading to maintaining a healthy weight.

This research set out to add value to maize germ and bran and develop new and improved healthy products for human consumption. The aim was to contribute to the improvement of food security, human nutrition and health.

The research resulted in the development of four viable value-added bakery products with good consumer acceptability. The research has also paved the way to use bran and germ innovatively to develop value added products with health benefits. The products serve two purposes; provide nutritional benefits to the consumer and economic benefits to the manufacturers (millers; and bakery and confectionery industry).

APPROACHES AND RESULTS

The research involved the stakeholders in the maize value chain and mainly targeted the millers/processors who produce maize bran and germ and the local bakery and confectionery enterprises. The approach to the research was to use one local bakery and confectionery enterprise and one large maize miller located in Kampala District Uganda.

The raw materials used to make the products (bread, cookies, cakes, buns sticks) were wheat flour, maize bran,

maize germ, soy flour, fat, sugar, yeast, salt and water. Soybean flour was purchased from a local soybean company.

Maize bran and maize germ were obtained from Maganjo Grain Millers Limited, a local grain milling company. Wheat flour, yeast, fat, sugar and salt were obtained from a local market in Kampala City. Wheat flour was replaced by maize bran, maize germ and soy flour at different levels of 0%, 10%, 20%, 30% and 40% to produce enriched balanced bread. Maize bran was substituted in the range of 4 to 15% and maize germ in the range of 1 to 10%. For cookies and cakes the formulation levels were up to 40% maize germ and bran.

All formulated products were baked at 200°C for 30 minutes. The readiness of the products was determined by the development of a golden brown colour. Proximate analysis was conducted on all samples to determine chemical composition. The specific volume of bread was determined using recommended methods. Bread-crumbs hardness was also determined. The samples made from the different combinations were assessed in a sensory evaluation laboratory by a panel of 35 untrained judges on a nine-point Hedonic Scale. The evaluation looked at the general appearance, colour, aroma, taste and overall acceptability. The aflatoxin content in the bread was also determined.

KEY FINDINGS

- The findings indicated that mixing bran, germ and soy and wheat can produce an acceptable bread product.
- At 30% substitution, the bread had the highest loaf weight and crumb hardness.
- At 20% substitution, the bread had an overall good general appearance and acceptability.
- Bread with maize bran and germ added at levels ranging from

5-15% had high protein, fat ash, fiber and energy content.

- Aflatoxin content for all the tested bread was less than 0.005 ppm, acceptable level.
- The optimised incorporation of 40% for maize bran and 20% for germ resulted in cakes and cookies with good eating qualities. Bread buns could only take a maximum of 20%. The interesting observation during the production of cookies and cakes included: the dough with maize bran during processing requires more water for mixing. This is attributable to the high water intake of maize bran.
- The products made by incorporating maize bran, tasted too sweet leading to the reduction of sugar in the recipe. This has the health implication of reduced sugar intake by the consumers.
- The baked product made by incorporating roasted bran resulted in some of the bran crystals being tasted in the final product. This taste was more appreciated in the cookies than in cakes.
- Products (cakes and cookies) made by incorporating maize bran have a superior crumb crust compared to 100% wheat.
- The cakes made by incorporating roasted bran had a longer shelf life, up to 7 days and still tasted fresh compared to other cakes with only 3-4 day shelf
- The incorporation of maize germ improved the visual appearance of the baked products and the nutritional quality of the products. However, care has to be exercised to keep its incorporation at low levels as its flavour is quite strong and not well appreciated.

IMPLICATIONS OF THE FINDINGS

- Findings indicated that the incorporation of maize bran and germ in wheat flour can produce bread, cookies, cakes,

buns and sticks with good general appearance and overall acceptability equivalent to that of 100% wheat.

- Incorporating and optimised maize bran and germ can produce bread, cakes and cookies with good eating qualities.
- Incorporation of maize bran and germ at level ranging from 20 to 30% can result in a good acceptable bread without compromising on the eating quality.
- Incorporation of maize bran and germ in baked products such as cookies and cakes improves the taste, visual appearance and shelf life.
- Incorporation of maize bran reduces the amount of sugar added and increases the amount of water added during the dough making process. Roasted bran has a bigger impact on the desired sweet taste of cookies

POLICY RECOMMENDATIONS

- Policy must focus on how to integrate the utilisation of maize bran and germ in foods for human consumption by processors.
- Implement the mandatory inclusion of a certain percentage of maize bran and germ in the processing of bakery and confectionary products by the processors.
- Formulate a standard for maize bran and germ as raw material for production of human food.
- Sensitise the population on the nutritional and health benefits of maize bran and germ when incorporated in bakery and confectionary products. Organise campaigns to educate consumers about the dietary and health benefits associated with consumption of high fiber foods.
- Maize millers should be educated on how to handle maize bran and germ as raw material of economic value and for human food production.



Figure 1: Bran and germ cakes and cookies made from maize



Figure 2: Cup cakes: 50% wheat and 50% maize bran



Figure 3: Bran sticks: wheat, maize bran and germ



Figure 4:Wheat-maize germ cookies and buns (50:50%)

CONCLUSION

It is possible to develop high fiber baked products that are acceptable and of good quality using maize germ and bran. However, it demands a lot of time and finances due to numerous trials. To penetrate the market, consumer sensitisation on the health benefits of such products needs to be undertaken. Product branding should also be undertaken to support the commercialisation of viable products.

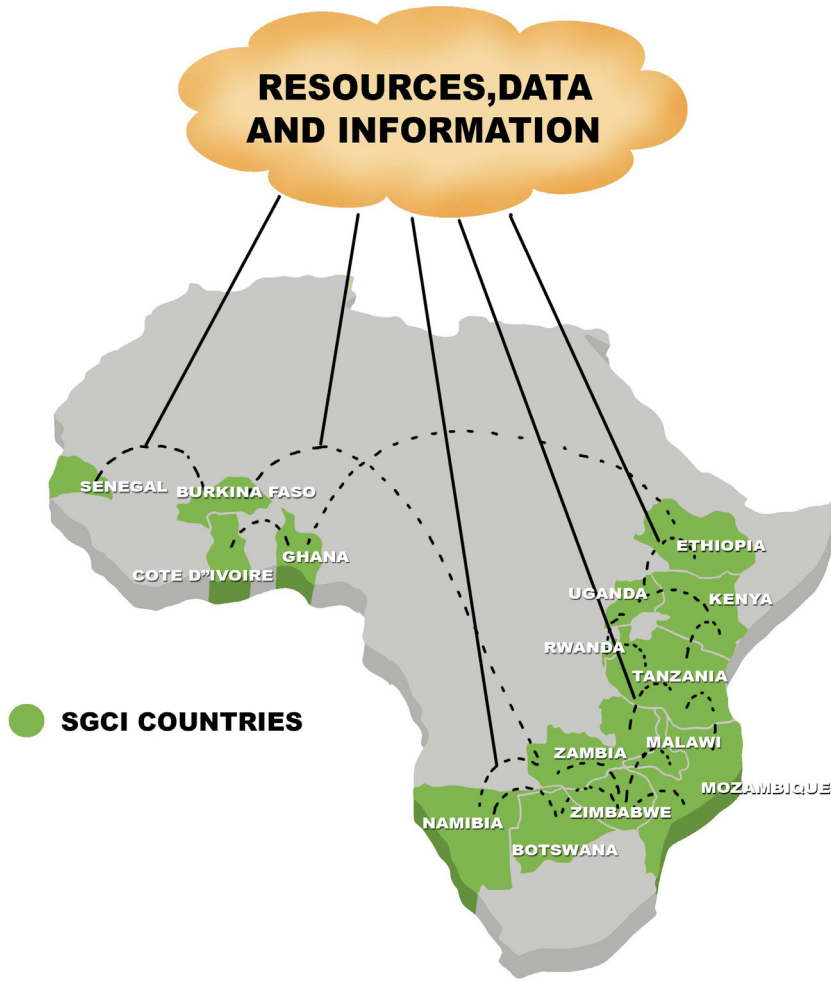
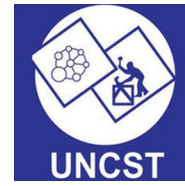
REFERENCES

1. AOAC. (2002). *Official Methods of Analysis of Association of Analytical Chemists International*. (17th ed.). Maryland, AOAC International.
1. Tajamul Rouf Shah, Kamlesh Prasad, Pradyum Kumar and Faith Yildiz (2016) *A Potential source of Human Nutrition and health*. A review: *Cogent Food and Agriculture* 2:1
2. Jack Daly, Danny Hamrick, Gary Gereffi, and Andrew Guinn (2017) *Policy brief: Maize Value Chain in EAast Africa Internation Growth Centre*.
3. Ian Dalipagic and Gabriel Elepu (2014) *Agricultural Value Chain Analysis In Northern Uganda: Maize, Rice, Groundnuts, Sunflower And Sesame Action Against Hunger* | ACF-International.

DOI:10.1080/23311932
2016.1166995.



Tanzania



The Scinnovent Centre
 Second Floor, Karen Plains Arcade
 P.O. Box 52486 - 00100, GPO, Nairobi, Kenya
 Website: www.scinnovent.org; Tel: +254 020 2173433