Extrusion processing of sorghum grain (whole and decorticated) used as ingredients for breads, biscuits and arraw

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ABSTRACT

In Senegal, interest in leveraging native local grains as food based consumption has grown simultaneously with the desire for new convenient forms of traditional products. Extrusion offers a cost effective path to generation of high quality fast cooking products from traditional grains. However, the extent to which extrusion can be applied to generate ingredients using local grain (degerminated sorghum) has not been fully explored. Decorticated sorghum grain (DSG) and whole sorghum grain (WSG) are often used as thick and thin porridges. In order to add more value to products made from sorghum grain, extrusion technology was developed for a single-screw extruder designed at Purdue University. Extruded DSG and WSG flours were tested as ingredients in breadcrumbing (15 to 30% incorporation), fast-cooking arraw (flour) (87 to 93% extruded DSG), and biscuits (20 to 70% extruded WSG). No significant differences were found between the extruded DSG and WSG incorporated flours at 15 and 20% in breadcrumbing, and were comparable to 100% whey flour bread. For arraw, hydrocolloids were added to arrive at commercial formulations. Extruded DSG with maltodextrin and gum arabic gave high yield on granule recovery (2 and 4 mm sieved) compared to traditional. Cooking time for 4 mm granules was reduced from 35 to 30 min with extruded DSG. For 2 mm granules, reduction was from 25 to 6 min. Sensory data showed WSG incorporated bread and fast-cooking arraw were highly acceptable to consumers. For biscuits made with 30% of extruded WSG showed good functional properties and sensory attributes compared to the control. 100% wheat flour: Extruded sorghum flours have high potential for new innovative products.

INTRODUCTION

Convenient products such as fully cooked instant cereal porridges are becoming highly sought after in developing markets [1] and represent a highly impactful product segment along the extrusion process. Extrusion processing is well-established in the modern food industry. As a high throughput process, this technology manages time, energy and cost compared to other forms of grain processing and cooking. For this study a single-screw extruder was used (Figure 1) and flour samples were used in food ingredients.

Figure 1: Single-screw extruder designed at Purdue University and used for the study.

This mini-extruder was designed with the intent of soybean processing for NASA and long term space missions. Purdue University, through a series of projects (IPL: AID-A0A-L-14-00320, SMS: AID-A0A-P-13-00071) and in collaboration with Technoserve, has commercialized this system in some African countries to develop high quality fast cooking flours for porridge production purposes, as the equipment is affordable for African enterprises. In most Sub-Saharan African countries, rural communities traditionally prepare meals from locally grown crops like millet, sorghum, and fava, which are considered Climate Resilient Crops. The continuing growing dependency of Africa to imported foods is a huge economic problem and makes the African food system highly vulnerable for disruptions like COVID-19 and the wheat and fuel crises due to the Ukraine war. Promoting the use of local grains into nutritious and convenient food products can reduce Africa’s dependency on imported wheat by developing value-adding processes that create new economic activities along the African food supply chain [2].

In Senegal, local cereals are essential foods because they are part of the composition of the dishes often eaten by the populations (rassou, porridge, “harini”, broken bread) [5]. Rolled products, intended for making a porridge, consist of fresh or dried granules. Furthermore, the Institute “Institut de Technologie Alimentaire” (ITA) of Senegal generated incorporation of millet and cassava flour in breadcrumbing. This study will focus on using sorghum extruded flour in different food commodities such as breadcrumbing, arraw and biscuit. These results could help to reduce the dependency mentioned earlier.

RESULTS ET DISCUSSIONS

The incorporation of extruded whole grain and debulled showed good bread volumes compared to non-extruded ones (in A) except for 30% incorporation, where the physical properties were lower. Hydration increased similarly with the incorporation of sorghum flour at 12 and 20% levels (in B). Regarding the whole grain flours, the increase trend in hydration is the same. While for the debulled grain flours, there was a change in behavior as the incorporation increased. This showed a good behavior of the whole grain sorghum extruded flour in breadcrumbing [2,3].

From results showed in (C), the incorporation of extruded sorghum flour using binding agents did not change significantly granule formation except for 7% Arabic gum. Also in (D), the extrusion presents an effect on reducing the cooking time. Starch undergoes structural changes (granulation, melting, and fragmentation). Rolled millet Arraw (not showed) present shorter cooking time compared to sorghum. Indeed, this difference could be explained by the presence of more amylopectin in sorghum. This difference in amylose influences gelatinization of sorghum flour, leading to a longer cooling time (4,5, 7).

For the sourghum buns, the 50% incorporation could be a good way to target for product development. With further sensory tests such as descriptive analyses with more trained panelists and characterization of the dietary fibers would help to better understand the incorporation of local cereals on biscuit development [8,9].

REFERENCES


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