Effects of extrusion cooking on functional properties of mixtures of full-fat soy and sweet potato

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Received 16 February 1998; accepted in revised form 12 October 1998

Abstract. Full-fat soy and sweet potato were extruded at 0:100, 25:75, 50:50, 75:25 and 100:0 ratios in an Insta-Pro 600 single screw extruder operated at 180, 200, 220 rpm respectively. Functional properties: bulk density, expansion ratio, water absorption and solubility indices and trypsin inhibitor were assayed. Results showed that addition of soybeans to sweet potatoes considerably increased the protein, fat, ash and trypsin inhibitor levels of the raw material mixtures. It also led to decreases in viscosities of raw mixtures, with corresponding increases in pasting temperatures. Addition of soybean significantly ($p<0.05$) affected expansion ratio, water absorption and solubility indices and trypsin inhibitor but not bulk density. Variation in screw rotation speed (rpm) significantly ($p<0.05$) affected only water solubility index at increasing speed. Extrudates generally received severe heat treatment, rendering them applicable only in soup bases, flour mixes and breakfast foods.

Key words: Blends, Extrusion cooking, Full-fat soybean, Functional properties, Sweet potato

Introduction

Extrusion cooking is capable of effectively and economically cooking, texturizing, and shaping a wide range of plant and animal food raw materials in a continuous operation [1]. The resulting food materials have been applied in human and animal feeding programs. Harper [2, 3] has reported that the current variety of food products obtained through extrusion cooking is impressive and continues to expand. The list of ingredients used in extruded foods consist of almost every imaginable food item. The principal ingredients are said to include all cereal grains, oil seeds, and legumes. In addition Mercier et al. [4] and various researchers, reported extrusion cooking of roots and tubers such as potatoes and manioc (cassava).

An increasingly important role of food extruders are assured in the food processing industry because of an increasing world population and shrinking conventional energy supplies [2]. These trends focus on the need to transform raw agricultural products consisting of starch, plant protein, and fat directly
and efficiently into foods of high acceptability. The ability of extruders to combine, cook, and texturize food components quickly, continuously, and efficiently makes them ideally suited to this task especially in the less developed countries (LDCs).

According to Anon [5], developing countries have been in search of technology to produce low cost nutritious foods. Harper [6] however reported that of all alternative processes available in processing soy-based foods in the LDCs, extrusion was found to be versatile, cost effective, and adaptable to the alternative energy needs of the LDCs [7].

Some machines already evaluated include the Brady and the Insta-Pro extruders [6-8]. Anon [6,9], Niak and Gleason [10] and Dubish et al. [11] have reported that the process has already been adopted in countries such as Kenya, Tanzania, India, Costa-Rica (pre-cooked blends with full fat soy flour for maternal health care), Sri Lanka (cereal-legume blends, ‘Thriposha’, for maternal health care program), the Philippines, Korea, and Pakistan. Other places include Guyana, Colombia, Mexico (‘INCAPARINA’ and ‘PRONUTRO’), Ecuador and Thailand [6]. Love et al. [12], Akinyele [13] and Dashiell et al. [14] reported on potential application of extrusion cooking in Nigeria.

Although the sweet potato is one of the most versatile energy and vitamin producers in the world [15], there is however a dearth of information on the application of the extrusion process in the processing of sweet potato or its combination with soybean. The major role the sweet potato is expected to play in the diet is that of providing energy. In addition, the crop has been cited as a good source of protein which is rich in minerals and vitamins [15, 16]. If boiled or baked, sweet potatoes are comparable on a cooked basis, with beans and cereals [15]; they have been shown to compare favorably with boiled beans, boiled rice, cereals cooked as porridge or made into noodles [15].

Villareal [17] cited five reasons which favor sweet potato utilization in today’s diet. These include the tremendous yield potential; high nutrient yield per hectare; dependability, due primarily to its drought tolerance and ability to withstand typhoon conditions; and acceptability to consumers because of its palatability; and low cost.

This study was undertaken to investigate the effect of extrusion cooking of mixtures of full-fat soy and sweet potatoes with respect to the functional properties of the extrudates.

**Materials and methods**

**Materials.** Orange fleshed varieties of sweet potatoes (*Ipomoea batatas*) were purchased from farmers in Makurdi, Benue State, Nigeria. Samsoy 2