Changes in dietary fiber content and its composition as affected by processing of black beans (*Phaseolus vulgaris*, Tamazulapa variety)

ENRIQUE ACEVEDO, LUIS VELÁZQUEZ-CORONADO & RICARDO BRESSANI

*Institute of Nutrition of Central America and Panama (INCAP), Guatemala, Guatemala*

Received 3 July 1992; accepted in revised form 10 May 1993

Key words: Common beans, Dietary fiber, Processing

Abstract. This paper presents the effect that the traditional cooking process of black beans (*Phaseolus vulgaris*, Tamazulapa variety) has on the quantity and composition of soluble (SDF) and insoluble (IDF) dietary fiber of beans, as well as on its protein digestibility and protein quality. There was an increase of IDF from 18.1% in cooked beans to 22.4% in fried beans, and a decrease in SDF from 8.4% to 6.6%, respectively. Starch content decreased from 34.5% to 31.3%. No change was found in lignin. The xylose content was higher in IDF than in SDF and decreased to some extent from cooked to fried beans. Arabinose content was similar in IDF and SDF with no change caused by processing. The fraction containing glucose, mannose and galactose in IDF was higher than in SDF, the content increasing in IDF and decreasing in SDF, with processing. Protein content in IDF was higher than in SDF, with no major change when processing. About 29.5% of the total protein of beans was bound in DF. Protein digestibility and protein quality decreased from cooked to fried beans and was positively related to IDF.

Introduction

Recently scientists have focused public's attention on the dietary fiber (DF) content of foods, since there has been some evidence that diets that are low in DF are related with several modern western diseases such as constipation, diverticulosis, colon cancer and coronary heart diseases [1, 2].

In developing countries diets are low in animal proteins of good quality and high in vegetable proteins of low protein quality. Intake of vegetable biomass is relatively greater in these countries [3]. In Central America for example beans (*Phaseolus vulgaris*) in their different preparations, are widely consumed as part of the basic diets of urban and rural areas. Intakes vary between 50–80 g/person/day [3]. Beans have been recognized as a good source of supplementary proteins for these populations [4], however, they contain between 25–30 TDF of which about 65% is IDF and 35% is SDF [5]. Therefore, intake of DF from beans will range from 12–24 g per person, per day, values that will increase from the consumption of other foods such as maize tortillas [5]. On the other hand, it has been shown that protein...
digestibility of beans is low [6]. At the present time various factors have been suggested to be responsible, one of which may be DF.

The different ways in which beans are consumed vary from one region to another, but basically there are three forms: whole water-cooked beans with or without their broth, blended and strained, and fried beans. Changes in chemical composition and nutritive value have been published before [7]. Some studies have indicated an increase in DF when foods are processed [8]. The physiological effect of dietary fiber (DF) is determined by the physical and chemical properties of the fiber's components [9]. At the present time there is no available information of the chemical profile of soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) of black beans after heat treatment. This aspect could be of importance, especially in relation to the poor digestibility of bean protein.

The purpose of this study was to analyze the changes in DF, both in quantitative and qualitative terms of black beans, which were processed in the different consumption forms and relate this change to the protein digestibility and quality in rats.

Materials and methods

Sample preparation. Black beans (Phaseolus vulgaris Tamazulapa variety) harvested in March 1988 in Jutiapa, Guatemala were kept refrigerated at 4 °C until used in the studies described. Cooked beans were prepared by mixing boiling water with clean seeds (3:1 v/w), cooked at atmospheric pressure for 2 hours, dried with its broth, in an air oven at 40 °C for 18 hours and milled to pass a 0.5 mm metal screen of the Cyclotec Mill (Tecator, Sweden). The blended-mashed beans were first cooked as described above. After the initial cooking, vegetable oil was added to 100 g of cooked bean flour (25% v/w) and cooked at atmospheric pressure for another 15 min then dried and milled as above. Fried beans were prepared as blended beans only that 25% v/w more vegetable oil was added and cooked until most of the water content had evaporated and had reached a paste-like texture. It was then dried and made into a flour. For the chemical analyses, samples were defatted by maceration in ether during 36 hours.

Chemical analysis. The residual moisture content and the ash, fat and protein analyses were carried out by the AOAC procedures [10].

Analysis of dietary fiber. Samples were treated for DF analysis according to Asp [11]. A defatted sample (0.5 g) was incubated in buffer pH 6 and 100 μl of Termamyl 1 (Novo Industries), and kept in agitation at 100 °C during 20 min. After reaching room temperature, pH was adjusted at 1.5 with HCl. One ml of pepsin (Merck No. 7190) 10% v/w solution was added and incubated for 1 hour at 40 °C. After cooling, pH was adjusted to 6.8, and 1 ml of pancreating