NUTRITIONAL EVALUATION OF DRY-ROASTED NAVY BEAN FLOUR AND MIXTURES WITH CEREAL PROTEINS

N. R. Yadav and Irvin E. Liener
Department of Biochemistry, College of Biological Sciences, University of Minnesota, St. Paul, MN 55108

ABSTRACT

A navy bean flour prepared by dry roasting in a salt bed as a medium of heat exchange was found to have a higher PER than beans which had been autoclaved in the conventional manner. This difference was attributed to a small but significant improvement in the digestibility of the protein. The PER of the roasted beans was higher than the autoclaved beans even in the presence of supplemental methionine. When various proportions of roasted beans and corn were fed at a level of 8.3% protein in the diet, a mixture in which 40% to 60% of the protein was provided by either beans or corn had a PER essentially the same as casein. Diets containing roasted beans and various cereal grains (oats, barley, buckwheat, wheat germ, and rice) were formulated in proportions calculated to give the highest chemical scores. In most cases the PER's were not significantly different from that of casein, and, in the case of rice, the PER was higher than that of casein. Supplementation of such diets with their first limiting amino acid failed to produce a further enhancement of the PER.

INTRODUCTION

Legumes constitute an important potential source of dietary protein which has yet to be fully exploited (Milner, 1972). Although their protein content is high (18-32%) and they already have a high level of consumer acceptance in many parts of the world, their use is restricted by the fact they contain a number of antinutritional factors and are deficient in the S-containing amino acids. By properly soaking and cooking beans, however, one can produce a
very palatable dish which, when eaten in combination with cereal grains, is also highly nutritious. Nevertheless, the use of beans would be considerably expanded if there were available a product of greater stability and uniformity and in such a form that it could be incorporated directly into other food dishes without the tedious time-consuming steps of presoaking and cooking. For example, pre-cooked dehydrated whole beans or bean flour would extend the utility of beans by permitting their incorporation into mixed blends with cereal proteins for use as a weanling food, in the formulation of baked goods, pancake flour, pizza, tortilla, and as a meat extender. Bean flours have been usually prepared in the past by soaking the beans in water, cooking for an appropriate period of time, and finally dehydrating by drum or roller drying (Elias et al., 1973; Bakker et al., 1973). To introduce water only to remove it again is obviously a wasteful and expensive process. Another disadvantage of such a cooking process is the fact that free amino acids, which constitute as much as 10% of the weight of the bean (Bell et al., 1977), may be leached out into the cooking water and lost unless the latter is recovered. The alternative of dry roasting beans in the absence of moisture has been generally regarded as an ineffective means of improving the nutritive value of beans (Klose et al., 1948; DeMuelenaere, 1964), although more recent studies have shown that the dry roasting of soybeans (Harper and Lorenz, 1974; Olsen et al., 1975) and navy beans (Carvalho et al., 1977) can effectively enhance the nutritional value of the protein.

This paper will deal with the nutritional evaluation of a navy bean flour which has been prepared by dry roasting in a bed of granular salt as a medium of heat exchange. Data are also presented which indicate that the nutritive value of such a product may be significantly enhanced by complementation with a wide variety of cereal proteins.

**DRY-ROASTING PROCESS**

A schematic drawing of the equipment used for the dry-roasting process is shown in Figure 1. This process is based on the use of a heated bed of granular salt as a medium of heat exchange. The design of the equipment is similar to that originally described by Benson (1966) and later used by Harper and Lorenz (1974). In this process whole navy beans (Sanilac or Seafarer variety, Phaseolus vulgaris), which have been rejected for use as canned beans because they are split or otherwise damaged, are introduced into a hopper and become mixed with granular salt being introduced into an inclined, rotating drum ("contactor") via a screw conveyor. Gas burners are used to apply heat to the outside of the contactor, and the mixture of beans and salt are conveyed forward by the action of helical flights within the contactor. The speed of the rotation of the contactor is such that the beans are in contact with the heated