Chapter - I

INTRODUCTION

India is the second largest rice producing country in the world and the production of rice in the country was 56 million tonnes during the year 1980-81(Anon,1982). One of the most valuable by-products of rice milling industry is the rice bran and its potential availability in the country has been estimated to be 2.5 million tonnes (Gaur and Sadasivam,1981). Rice bran is considered to be a potential source of oil. Moreover its high contents of protein, sugars and other carbohydrates make it a good feed as well as food supplement. As rice bran contains valuable B-group vitamins, amino acids, phosphoric acid compound etc. it is also useful in the medical field.

For the various successful utilisations of bran, different processing operations like handling, storage, drying, stabilization, pelletisation etc. are necessary. A knowledge of the physical, thermal and electrical (dielectric) properties of rice bran is hence important, since these basic informations should be of value not only to the engineers, but also to food scientists and processors who may exploit these properties for better processing operations. Information on the physical characteristics of rice bran is essential in many problems associated with the design of a specific machine or analysis of the behaviour of the product in various processing operations. A knowledge of the thermal properties of bran is required not only for quantifying the thermal processes but also for designing processing systems.

The dielectric properties of bran have been of interest because of its correlation with moisture content and because to a large extent, they determine the absorption of energy in dielectric heating applications. A review of literature revealed that very few attempts have been made in the past to determine the physical, thermal and dielectric properties of rice bran in relation to the various factors, namely, moisture content, temperature and bulk density.

The most important utilisation of rice bran is the production of oil, since rice bran, when relatively free of hulls, contains about 15 to 25 per cent oil. The potential yield of rice bran oil in the country is 3,75,000 tonnes, but the actual production in 1980-81 was only 1,30,000 tonnes out of which the edible grade oil was only 4000 tonnes, and the rest was industrial grade oil which was used in soap industry (Sheth, 1981).

Because of its low linolenic acid content and its capacity to lower serum cholesterol level, rice bran oil is considered to be a high class edible oil. Owing to the acute shortage of edible oils in India, it is most desirable to exploit the possibility of extracting edible grade oil from the bran produced in the country.

The main reason for the under-utilisation of rice bran for edible purposes is the time lag between the production of bran and its extraction. If the oil is not extracted from the rice bran immediately after its removal from rice, the oil contained in the bran is hydrolysed into free fatty acid (FFA) and glycerol by the action of very active lipase enzyme present in it. Rate of FFA release may be very high, sometimes as much as 5 to 7 per cent

splitting can occur in a single day and about 70 per cent in about a month under favourable conditions (Desikachar, 1977). Spoilage may also occur as a result of oxidation leading to various odoriferous compounds including aldehydes, ketons etc. Crude bran oil with FFA content more than 10 per cent is not generally suitable for edible oil production and hence such oil is used for manufacture of soaps and other industrial purposes(Enochian et al.,1981). In practice, however, the quick collection and extraction of bran within a few hours of its production is not possible. The scattered location and small sizes of most of the rice mills make it difficult to collect suitably large quantities of fresh bran for the economic extraction. This difficulty can be overcome by stabilization of rice bran, which is the process of inactivating the lipolytic enzymes in freshly milled bran so that the increase of FFA in rice bran oil is checked and the oil can be used for edible purpose after extraction.

Out of the different existing methods of stabilization of rice bran heat treatment method, either wet or dry, has been found to be the most effective one. However, in wet heat treatment method, the stabilization may not be complete, as the bran is so fine that steam penetration is difficult and clumps with dry centres form if agitation is not adequate. Moreover, most of the rice mills do not have boilers to produce steam required for stabilizing bran. The problems associated with dry heating method are the prolonged heating time and the difficulty of achieving uniform temperature in rice bran. The heat treatment given should be minimum, as otherwise the oxidative spoilage may take place,

although hydrolytic spoilage is prevented. Besides, the high temperature treatment for long periods can reduce the nutritional value of the bran.

The various techniques for rice bran stabilization developed so far have been mostly on laboratory experimental basis, and no successful commercial stabilizer is available in India. It is either due to the difficulty of heating the bran uniformly on a commercial scale, or due to other practical limitations of the methods adopted. In order to achieve complete stabilization, each and every particle of rice bran should be heated to the required temperature and time and at the same time heat treatment given should be minimum to avoid nutritional losses. In view of the draw backs associated with the external heat treatment process, one of the possible methods for rapid and most uniform heating of rice bran, which has low thermal conductivity, is the utilisation of radio-frequency(RF) dielectric heating. The dielectric heating has the unique advantage of generating heat internally in materials which are not readily heated by other means. Therefore, it was hypothesised that the internal heating of bran by RF energy would most effectively inactivate the enzymes responsible for the deterioration of rice bran oil. No attempt has been reported so far on the use of RF dielectric heating for the stabilization of rice bran.

The present series of investigations were, therefore, undertaken with the following objectives:

(1) Determination of some physical properties. namely, average particle size, bulk density, true density and porosity of rice bran at different moisture contents.

(2) Determination of thermal properties namely, specific heat, thermal conductivity and diffusivity of rice bran at different moisture contents, temperatures and bulk densities.

(3) Determination of dielectric properties namely, dielectric constant, loss tangent, dielectric loss factor and a.c. conductivity of rice bran at different moisture contents, temperatures, bulk densities and frequencies.

(4) Study of the drying characteristics of rice bran exposed to radio-frequency dielectric heating for different initial moisture contents, exposure times and bulk densities.

(5) Dielectric-heating treatment of rice bran for stabilization.

(6) Study of the effect of dielectric-heating treatment for stabilization of rice bran, in terms of changes in FFA and moisture contents of the treated bran during different periods of storage.