## ABSTRACT

Rice grain shaped pasta product, designated as "Rice Analog", was prepared from broken rice (cultivar - kavirajsal) in conjunction with other protein - materials (wheat gluten, blackgram flour, gelatin) as functional supplements. The optimum level of protein was determined in relation to the cooking stability of the product. Based upon some experimental data and assumptions, a laboratory scale cold forming extruder with various funtional components therein was designed in matching with a production of 5 kg/h rice analog and fabricated indegenously.

The extruder consisted of a stainless steel barrel (25 mm ID, 40 mm OD, L/D ratio of 9.0) inside which a stainless steel helical flighted screw (24 mm diameter, compression ratio of 3, flight depths at feed end 6 mm and discharge end 2 mm, effetive length 210 mm, flight width 4 mm) was allowed to rotate closely. Feed dough was introduced inside the barrel through a feed hopper and feed screw assembly. The feed received by the extruder screw was propelled at the other end of the barrel under sufficient pressure to extrude out through specified die holes. The extrudate strings were cut into desired length with a rotary cutter. The power was transmitted from a D. C. motor to the extruder screw shaft, wherefrom the required power to drive the feed screw and cutting wheel shaft was transmitted through gears and sprockets - chains assembly at synchronized speed ratios.

The studies carried out with the manual extrusion of rice analogs with different ingredients/treatments indicated that the products containing either 12 % gluten or 25 % blackgram flour gave minimum leaching loss on cooking. Hence, these two blends were considered as optimum.

The effects of different variables like extrusion screw speed, particle size of rice flour and type of feed ingredient on different machine parameters like volumetric flow rate of the extrudate, specific energy, extrusion pressure, and product parameters like physical, physico - chemical and mechanical properties were studied. Products obtained at 60 rpm screw speed using rice flour particle size below 50 mesh (average particle size 133 μm), designated as composite flour, gave minimum leaching loss irrespective of the type of feed ingredients.

Various regression equations correlating the particle size of rice flour and screw speed with mchine parameter like, the volumetric flow rate, pressure, specific energy or product parameters like leaching loss, true water uptake, bulk density and hardness were obtained. The drying air temperature of 313 k at 0.5 m/s was found to be optimum to give desired quality parameters of the products when they were compared with other control samples like raw rice and commercial wheat pasta in their cooking behaviour.

Organoleptic evaluation of the cooked rice analog showed that both the feed blends were acceptable by the taste panel. Correlations between the sensory parameters and the instrumental

textural analysis data were envisaged for the cooked products. The outer surface and cross sectional microstructures of both the rice analogs containing either 12 % gluten or 25 % blackgram flour showed minor differences in terms of voids, cracks and grain structure.

A process technology for the production of rice analog was suggested. The developed extruder was found suitable for preparation of rice analog using the optimum feed blends under synchronised speeds of the extruder screw, feed screw and the rotary cutter.

**Key words :**

Broken rice utilization

Rice analog

Reconstituted rice grains

Rice based macaroni products

Pasta products

Extruder design

Cold forming extrusion

Rice analog drying

Rice analog microstructure