Making rice more nutritious

MUHAMMAD IKRAM UL HAQ enlists methods to improve the protein content of rice polishing

24.11.02
Agri Nation

The growing feed industry of Pakistan has always faced shortage of quality ingredients both of vegetable and animal origin. The production capacity of this industry has further broadened the gap between the demand and supply. This situation urged the concerned authorities to find novel protein sources and development of scientific methods of enhancing the nutritive value of existing non conventional feed resources either by mechanical, chemical, physiochemical or biotechnological methods.

Fermentation technology, a part of biotechnology, has been used for the production of food from a variety of materials. This is the process through which the carbohydrate rich products, by-products and waste products are fermented with different kinds of microorganisms like bacteria, yeast and fungi. Each type has its own potential to utilise substrate and synthesise products like protein, free amino acids, enzymes, vitamins and many other useful products.

The main objective of the current research was to upgrade the protein value of one of the agro industrial waste, that is rice polishing through fermentation for its utilisation in poultry rations. The research work was completed in three phases. The first two phases were fermentation phases while the third one was a trial phase. During the first phase, rice polishing (substrate) was fermented with a fungi (Arachniotus species) under different conditions. The first phase fermented substrate was re-fermented during the second phase with a bacteria (Brevibecerium flavum) under different conditions. During the third phase of the research, the finally fermented substrate was dried and fed to broiler chicks after mixing in their basal rations at different levels. Six biological parametres were studied in broiler chicks for determining the efficacy of fermented substrate.

The Rice polishing, which was of rice industry. It is procured as final by-product after the complete processing of raw rice. Rice polishing is mainly used as fire material for bricks making and energy supplement in poultry rations because of having high oil contents (12-14 percent). There are few oil extraction plants which extract oil and it is used in the Banaspati Ghee industry and Soap industry. The oil extracted (deoiled) rice polishing losses its value for poultry rations. That deoiled rice polishing was upgraded to a good quality vegetable protein supplement through the process of fermentation for its utilisation in poultry rations.

The *Arachniotus* species is a friendly fungi whose role has been established as an antagonistic fungi against plant pathogens. Later research also established its role for the production of Single Cell Protein (SCP). This fungi degrades the cell wall of the substrate on which it is grown, hence liberates growth. When the growth conditions (acid treatment of substrate, determination of carbon to nitrogen ratio of the medium, supplementation of sugarcane molasses to the medium, supplementation of corn steep liquor to the medium and determination of harvesting time for maximum yield of biomass protein) of this fungi were determined on the rice polishing, it raised the True Protein contents of medium from 11 percent to 18 percent through 48 hours fermentation of five percent acid treated rice polishing, under 10:1 carbon to nitrogen ratio, after supplementation of the medium with one percent molasses and 0.5 percent corn steep liquor.

The *Brevibacterium flavum* is also a friendly bacteria which synthesises Lysine, and is an essential amino acid. Its mutant strain is known as to produce 60 grams Lysince per litre of the fermentation medium but in present research, its wild strain was ity of mutant strain, which produces less amount of Lysine. The medium pre-fermented with *Arachniotus species* was used as the growth medium for the *Brevibacterium flavum*. When the growth conditions (inoculation condition, supplementation of sugarcane molasses to the medium, supplementation of glucose to the medium, supplementation of yeast sludge to the medium and determination of harvesting time for maximum yield biomass protein) of this bacteria were determined, it raised the True Protein contents of the medium from 18 percent to 20 percent through fermentation of sterilised pre-fermented medium, after supplementation of the medium with two percent glucose and one percent yeast sludge.

Following all the optimised conditions of first and second organisms, the fermentation was carried out in laboratory scale fermenter for the determination of growth kinetics of both the organisms and ultimate production of the biomass. The specific growth rate, grams of protein formed per gram of substrate utilised (Y p/s), specific product quotient (qp) and specific substrate uptake rate (qs) determined for both the organisms were 0.035h-1 and 0.014h-1, 0.25 and 0.432,0.0175 gram product/gram cell-hour and 0.07 gram cell/gram substrate/hour and 0.0228g cell/g substrate/hour respectively.

The biomass prepared in bulk in the fermenter was dried and ground. Its chemical analysis was

was determined and finally its biological evaluation was also conducted. The chemical analysis revealed that the inherent crude protein of the rice polishing (13 percent) was raised to 37 percent. The amino acid profile revealed that the quantity of Lysince was raised from 0.68 percent to 1.38 percent. When grams of Lysine per 100 grams of crude protein was calculated, it was 3.92 which was only 0.28 grams less as compared to that of FAO reference protein. The chemical score declared methionine as the first limiting amino acid in the biomass.

For biological evaluation, six experimental rations that is A, B, C, D, E and F were prepared. Ratio-F was protein free ration, which was used for the determination of internal nitrogen losses. In rations A,B,C,D and E, biomass was added to the basal ration at 0,25,50,75 and 100 percent level as replacement of fish meal (a standard animal protein). These six rations were fed to six groups of broiler chicks for testing the efficacy of biomass protein. For this purpose feed intake, weight gain, feed conversation ratio, protein digestibility, biological value, net protein utilisation and protein efficiency ratios were determined in the broiler chicks. It was concluded from the results that although chicks were fed on fish meal only, performed well as compared to chicks fed on biomass only, however, its efficacy was not so poor when added to the basal ration at 75 percent replacement of fish meal.

When the economic feasibility of its production was calculated on the laboratory scale fermenter, it was found out that it was uneconomical as compared to other vegetable protein supplements. However, its cost of production can be reduced when it will be produced on commercial scale.

Following results were achieved after the research:

*. The rice polishing's crude protein contents raised from 13 percent to 37 percent in the finally prepared biomass.

*. The purpose to enrich the Lysine contents of the rice polishing was also raised from 0.68 percent to 1.38 percent through the two step fermentation.

*. The biomass prepared was more digestible as compared to the deoiled rice polishing.

*. The aim to use by-products of other industries that is molasses, corn steep liquor and yeast sludge during the process of fermentation was also achieved.

*. The biomas successfully