PART-I

FOWL NUTRITION
SECTION-A

SUITABILITY OF RICE GERM IN THE NUTRITION OF CHICKS
CHAPTER - I

OVERALL COMPOSITION OF RICE GERM
It has been mentioned in the introduction that one major aspect of the present studies is in the area of FOWL NUTRITION. Under this item the suitability of three food ingredients are dealt with: one is rice germ, another prawn shell powder, and the third, dehydrated beef powder. One aim in this investigation was to search for new ingredients to be tried in the fowl feed. Though rice germ forms usually a part of the rice polish which is the main item in fowl feed in India, in modern milling practice most of the germ of paddy is sorted out along with broken grain and so it does not form part of the animal feed. Moreover, there have been reports of inadequacies of the rice polish (Ghousuddin and Talapatra, 1969) and we suspected that the high mortality among chicks fed with rice polish in their experiments might have been due to the lack of rice germ in the rice polish used. One reason adduced by these authors was lack of vitamin E and it is known that rice germ is rich in it (Raghunatharao et al. 1960; Taeinfel et al. 1962).

One of the earliest reports on the analysis of rice germ was that of Shin Sawamura (1920) on the germ of a Japanese variety of paddy. He gives the composition as follows: Moisture 5.73, crude protein 24.30, crude...
fat 20.12, lecithin 0.93, sugars 10.79, starch 14.89, 
crude fibre 9.72 and ash 13.47 grams in 100 grams of 
rice germ. In addition to this reference, considerable 
evidence has accrued during the last several years as 
to the nutritive value of rice germ (Ineo Takeuoh, 1953; 
The chemical composition of rice germ with respect to 
aminoc acids, vitamins and minerals by Kik (1954, 1957) 
led him to the conclusion that "the high nutritive value 
of the rice germ merits introduction into human foods 
and animal feeds as has been done with wheat germ." That 
the rice germ is rich in essential fatty acids and vitamins 
has been respectively demonstrated by Rya and Taro (1933) 
and Keizo and Tanaka (1933). That the rice germ compared 
to rice bran, white rice and hen's egg is rich in nicotinic 
acid has been reported by Kasuo (1949) and its richness 
in mineral content by Santos and Almersa (1954). The 
amino acid composition of rice germ protein by microbiol- 
ogical assay has revealed that it contains as many as 
14 amino acids of which glutamic acid, arginine, lysine 
and valine are in appreciable quantity (Ineo and Takeuoh, 
1955). That the addition of defatted rice germ to the 
rat feed improved their protein efficiency has been demon- 
strated by Viviani et al (1959). As far as we are aware
no analytical work on the rice germ has been done in India and its suitability has not been tried. The present investigation is therefore designed to assess the value of rice germ as a feed additive. First of all some analytical work has been attempted and later on feeding trials were conducted.

MATERIAL AND METHODS

The rice germ analysed in these studies is that of the common variety of paddy known as Gimsali. The following are the procedures.

Moisture Content:

A known quantity of rice germ was placed in a glass dish in an air oven maintained at 100°C. to have it dried completely. The material was cooled in a desicator and weighed. The process of heating, cooling and weighing was repeated till difference in weight between two successive weights was found to be less than one milligram.

Glycogen Content:

The glycogen content of the rice germ was estimated according to the method of Seifter et al (1950). A known
Fig. 1 STANDARD CURVE FOR GLYCOGEN

Optical density

Microgram glucose
quantity of rice germ was digested with 2 ml. of 20 per cent alcoholic KOH in boiling water. To this an equal volume of 95% ethanol was added and kept overnight at 4°C. to precipitate glycogen. A set of five tubes were thus prepared. They were centrifuged and the supernatant was poured out. The residue was then washed with distilled water. A known aliquot in triplicate was analysed for glycogen content by the anthrone method. The intensity of colour read on spectronic 20 at 620 mu. \( (\text{Eq. 1}) \) Glucose was taken as reference standard. 1.11 was used as conversion factor for glycogen. The results are expressed as mg. glycogen (glucose equivalent)/g. wet weight of rice germ.

**Free Sugars:**

About 1 g. of rice germ was homogenised with 5 ml. of distilled water. To the homogenate was added 35 ml. of distilled water, 5 ml. of 10 per cent sodium tungstate and 5 ml. 2/3 H sulphuric acid. The mixture was shaken thoroughly and kept for 20 minutes for the precipitation of proteins. 1 ml. aliquotes of protein-free extract was tested for free sugars following the method of Folin and Wu (1920) as described by Hawk et al (1954).
**Ether Extract:**

About 5 grams of the oven-dried material was weighed and extracted with sufficient petrolatum ether for about 8 hours in Soxhlet apparatus. The extraction was continued till a constant weight of the extract was obtained.

**Total Fat:**

The total fat content was obtained according to the method of Folch et al. (1957), using 2:1 chloroform and methanol (V/V). A known quantity of rice germ was oven-dried at 100°C, till a constant weight was obtained. The dried material was then weighed and homogenised with appropriate volume of methanol in Potter and Elvehjem homogeniser. The homogenate was then transferred quantitatively in a 50 ml. separatory funnel and then the chloroform was added. The two solvents were partitioned by the addition of 0.2 ml. of water. After the funnels were shaken, they were allowed to stand overnight. The lower chloroform layer containing the lipid was drawn off, the solvent was removed under reduced pressure and the total lipid was estimated gravimetrically in triplicate. The results are expressed as per cent dry weight of tissue.
Crude Protein:

The percentage of crude protein was obtained by multiplying the nitrogen percentage obtained from a sample of the material by the factor 6.25. The nitrogen content was determined according to the procedure outlined in the ISI bulletin for poultry 1968.

Crude Fibre:

Fat-free sample of rice germ of about two grams was digested with 0.255N sulphuric acid as well as with NaOH of 0.31N successively. The undigested residue was washed with hot distilled water followed by 95 per cent absolute alcohol, and dried at 100°C. to a constant weight. The cooled residue was washed in a silica crucible and the crude fibre content was calculated as outlined in the ISI bulletin for poultry 1968.

Ash Content:

About 2 to 3 grams of the dried material was taken in a tared silica crucible and weighed. The material is then ashed in a bunsen electrical furnace at 300°C to 400°C till the material turns to a grey-white appearance. It is then cooled in a desicator and weighed. The material then reheated in a muffle furnace for one hour at intervals.
Fig. 2 STANDARD CURVE FOR TOCOPHEROL

μg dL-Tocopherol

Klett scale readings

10 20 30 40

90 80 70 60 50 40 30 20 10

100
till a constant weight is obtained. The percentage of ash is then calculated.

**Vitamin E Content:**

The vitamin E content of the rice germ oil was determined following the Eameric-Engel reaction as described in "The vitamins" (ed. Paul, Gyorgy and W.N. Pearson, 1967) and was calculated from standard curve prepared with dl- -tocopherol.

**RESULTS**

Summary of the gross organic composition, ash and vitamin E contents of the rice germ are as follows:

<table>
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<tr>
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<th>%</th>
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<tbody>
<tr>
<td>Dry matter</td>
<td>91.60</td>
</tr>
<tr>
<td>Glycogen content</td>
<td>8.40</td>
</tr>
<tr>
<td>Free sugars</td>
<td>3.60</td>
</tr>
<tr>
<td>Ether extract</td>
<td>28.00</td>
</tr>
<tr>
<td>Total fat (dry weight)</td>
<td>30.00</td>
</tr>
<tr>
<td>Crude protein</td>
<td>22.60</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>7.45</td>
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<tr>
<td>Ash content</td>
<td>10.90</td>
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Vitamin E 0.56 mg./100 mg. of lipid when determined without saponification
0.22 mg./100 mg. of lipid when determined after saponification.
From the analysis given above, it is seen that the rice germ is rich in fat and crude protein, but not in carbohydrates. There is thus an appreciable contrasting trait with the wheat germ; the total carbohydrates for wheat germ meal given by McDonald, Edwards and Greenhalgh, 1966, is 31.50, whereas the corresponding figure for rice germ will be very much less (glycogen 8.40, free sugars 3.60). On the other hand, this lack of carbohydrates is compensated by the presence of more fat in the rice germ (about 30.00%, dry weight). The difference between rice germ and wheat germ with regard to fat content is well reflected in the ether extract figures of the two germs (wheat germ meal 7.30 and rice germ 28.00). The only biological explanation which could be adduced for this contrasting feature is that in germination, rice germ has to produce more heat as its environment is wet land soil.

The crude protein values for rice germ and wheat germ are very close (22.60 and 24.90). Since the ash content value of rice germ (10.90 per cent) is comparatively more than that of wheat germ (4.3) it can be surmised...
that minerals are well provided in the germ as in the wetland some of them may be in short supply. Both rice germ and wheat germ are rich sources of vitamin E.

From the nutritional point of view for poultry, the two germs are easily comparable.

**SUMMARY**

1. The rice germ is rich in fat and crude protein. Compared to wheat germ, it is poor in carbohydrates but wheat germ is poor in fat.

2. From the nutritional point of view for poultry, rice germ as it contains good amounts of protein and fat and vitamin E as well as minerals, it can serve as a good additive in fowl feed.