

EFFECT OF PHYTATE CONTENTS OF CEREAL BY-PRODUCTS ON BIOAVAILABILITY OF TOTAL PHOSPHORUS IN POULTRY

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ABSTRACT

Four cereal by-products were examined for their total and phytate phosphorus contents. Feeding trial for bioavailability was conducted on 18 weeks old cockerels of White Leg Horn breed which were starved for 24 hours and were forced-fed 30 grams of finely ground single feed stuff and droppings were collected at pre-determined time intervals. The bioavailability of total phosphorus for wheat bran, rice polishing, wheat middling and gram kara was 37.11, 15.37, 61.32 and 62.64%, respectively while phytate phosphorus contents were 0.66, 1.16, 0.24 and 0.17%, respectively. The bioavailability of total phosphorus was negatively correlated with the phytate phosphorus contents of these feed stuffs ($P < 0.01$).

Key words: Cereals, phytate contents, bioavailability, poultry.

INTRODUCTION

Determination of available nutrients is extremely important for formulating a quality feed (Maynard and Loosle, 1969; Singh and Panda, 1990). Both quality and quantity play a critical role in the efficient use of feed for egg and meat production. Among minerals, the availability of phosphorus in plant sources is limited because the major portion of phosphorus is in the form of "phytate" and its salts, collectively termed as "phytin". This form of phosphorus has low availability for poultry (Gillis *et al.*, 1957).

Phytate is considered to be an antinutritional factor, which binds certain dietary minerals such as Calcium (Ca^{++}), Magnesium (Mg^{++}), Iron (Fe^{++}) and Zinc (Zn^{++}) and renders them unavailable for their physiological functions by forming insoluble compounds in the intestine. Phytate is a normal constituent of almost all cereals, cereal by-products and oil seed plants, constituting 1-3% by weight. About 60-90% of total phosphorus is in the form of phytic acid (Nelson, 1967; Nelson *et al.*, 1968).

The present study was conducted with the objective to examine the effect of phytate contents of cereal by-products on bioavailability of total phosphorus and to correlate phytate contents with available phosphorus.

MATERIALS AND METHODS

Bioavailability of total and phytate phosphorus was determined through an experiment in the Animal Nutrition Department at University of Agriculture Faisalabad. The experiment was conducted on

cockerels of 18 weeks old of White Leg Horn breed. They were housed in cages in an environmentally controlled room. The experimental birds were given stock diet for one week, followed by feeding test feed stuffs after starving for 24 hours. Prepared test feed stuffs i.e. rice polishing, wheat bran, wheat middling and gram kara were allotted to 12 test birds at random. Thirty grams of each feed stuff was fed to 3 birds by force-feeding (Sibbald, 1976). Samples of test material were analyzed for dry matter contents at the same time. Endogenous and metabolic losses were estimated in four control birds. The excreta voided during subsequent 48 hours were collected quantitatively in collection trays separately, freeze-dried and then weighed (Sibbald, 1982). The excreta and samples of test material were analyzed for total (AOAC, 1984) and phytate phosphorus contents (Wheeler and Ferrel, 1971). The bioavailability was calculated as under:

Bioavailability =

$$\{ I_p (E_p - C_p) \div I_p \} \times 100, \text{ where}$$

I_p = Intake of phosphorus

E_p = Excreta phosphorus

C_p = Excreta phosphorus of control birds

RESULTS AND DISCUSSION

Phytate phosphorus

The data in Table 1 show that rice polishing has the highest phytate contents, while gram kara contained the lowest value for the same. The phytate contents of rice polishing (88.87%) and wheat middlings (74.91%) in the present study are almost equal to 89.3 and 74.44%, respectively reported by National Research Council (1994). The phytate contents of wheat bran (79%) are

comparable to 71% reported by NRC (1994). The value for gram kara (59.25%) was almost similar to that found in barley (58.2%).

Bioavailability of total phosphorus

The total phosphorus contents of rice polishing (1.13%) are quite similar to 1.31% reported by Hubble (1989). Wheat bran contained 0.84% total phosphorus which is quite low as compared to the reported values (1.15 and 1.30%) of other workers (Hubble, 1989; Bolton and Blair, 1973). Similarly, wheat middlings contained very low value of total phosphorus (0.32%) as compared to 0.80% reported by Hubble (1989). This difference might be due to different variety, soil type, frequency of irrigation and other agronomic practices

(Miller *et al.*, 1980; Reddy and Salunkhe, 1981). The values of total phosphorus for gram kara was comparable to that of wheat middlings.

Rice polishing contained 0.20% available total phosphorus which is quite high as compared to reported value (0.10%) by Bolton and Blair (1973) and comparable to the value (0.14%) by Hubble (1989). The difference might be due to the available phytate phosphorus ignored by Bolton and Blair (1973). The value of available phosphorus for wheat bran (0.31%) was quite similar to 0.30% as reported by Bolton and Blair (1973) and 0.35% demonstrated by Hubble (1989). The total phosphorus bioavailability of gram kara was comparable to that of wheat middlings.

Table 1: Average total and available total phosphorus (P) and phytate phosphorus alongwith their bioavailability and correlations

Ingredients	Total P	Phytate P	Phytate P (%)	Available		Bioavailability		Correlation	
				Total P	Phytate P	Total P	Phytate P	R ₁	R ₂
Rice polishing	1.31	1.16	88.87	0.20	0.10	15.37	8.80	0.99	-0.96
Wheat bran	0.84	0.66	79.00	0.31	0.14	37.11	20.83	0.92	-0.92
Wheat middlings	0.32	0.24	74.91	0.20	0.12	61.32	48.38	0.99	-0.98
Gram kara	0.28	0.17	59.25	0.18	0.06	62.04	38.31	0.99	-0.99

R₁ = Correlation between total phosphorus and its bioavailability

R₂ = Correlation between phytate phosphorus and total phosphorus availability

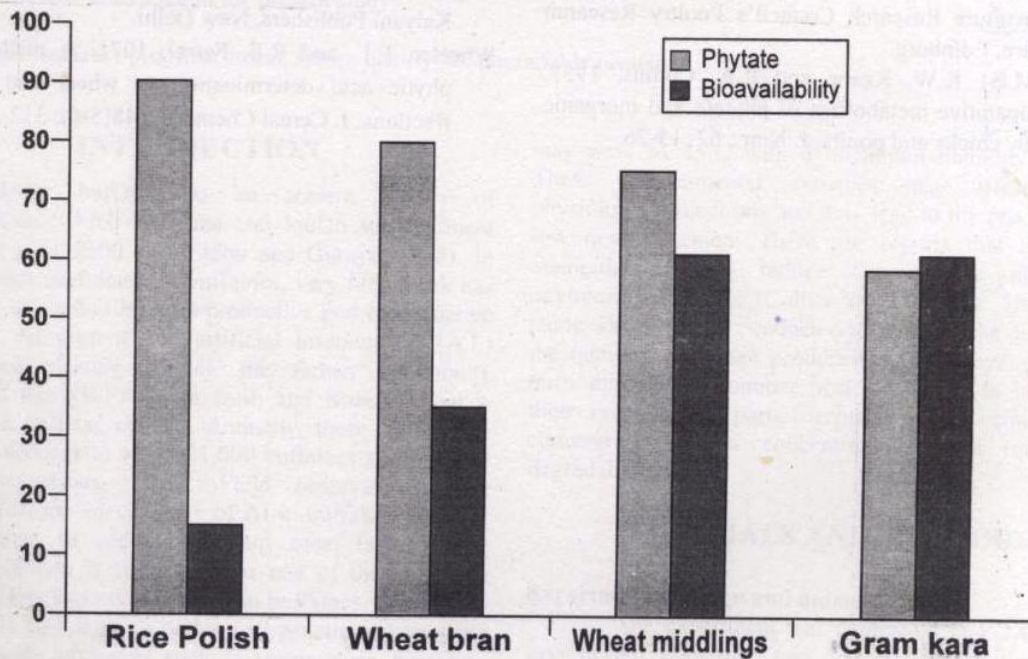


Fig 1: Effect of phytate phosphorus contents of cereal by-products upon bioavailability of total phosphorus

Table 1 shows that phytate phosphorus contents of cereal by-products were significantly ($P < 0.01$) and negatively correlated with the bioavailability of total phosphorus. It means, as the phytate contents increases in the ingredients, the respective bioavailability decreases accordingly. The high negative correlation is also clear from Figure 1.

Because on the results of this study, following conclusions can be made:

1. As the phytate contents of cereal by-products increases, total phosphorus availability decreases accordingly.
2. Total phosphorus availability in cereal by-products for adult poultry ranged between 15.37 and 62.64% and that of phytate phosphorus ranged between 8.80 and 48.38%.
3. Total phosphorus availability for poultry can be increased in the diet by increasing the phytate phosphorus availability.

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