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The Effect of Cell Wall Content of Wheat and Rice Brans on Biological Relative Bioavailability Value of Minerals Binding from the Broilers Diet

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Abstract

An experiment was conducted to study the effect of dietary fiber (DF) consist of NSP and lignin content of wheat bran and rice bran the relative biological availability of minerals supplementation in the broilers diet. A total of 120 broiler chicks (Ross 308) arranged with 4 repetitions (6 birds per each replicated) on the 5 treatments diet in metabolic cages. The experimental diets contain one control diet and 4 diets were formulated, basal diet containing 25% wheat bran and rice bran that those supplemented with multi-enzyme. Data shown that enzyme supplementation had effect on increase biological apparent Ileal digestibility values minerals of diets content wheat bran and rice bran were relatively high P digestibility. Thus, those cell wall were effected on bon quality characteristics and seedor index tibiae respectively (P<0.05). The present study shown that relative bioavailability values (biological availability), of minerals concentrations of wheat bran and rice bran as cell wall consist of non-starch polysaccharide and lignin source sources based on slope of regression response to control diet was set equal to 100%, on them on daily dietary minerals intake were estimated. Relative bioavailability values, based on daily dietary minerals intake, when response to control diet was set at 100%, were 30.78, 71.43, 0.64, 91.67, 96.15 and 138.46 for rice bran, as well; values of wheat bran are 50.00, 28.57, 1.82, 42.50, 46.15, and 30.77, respectively. The result of experiment indicated that Zn, Fe, Mn and P from rice bran, as well as, Ca, Mn, and Fe for wheat bran were have highly relative bioavailability values, with respect to amount of cell wall consist of non-starch polysaccharide and lignin sources.

Keywords: Wheat bran; Rice bran; Cell wall; RBV; Minerals

Introduction

The source of a dietary fiber consists of non-starch polysaccharide and lignin, has become of concern due to differences in chemical structure and variation in binding capacity [1-3]. The Investigations of mechanisms in mineral binding by dietary fiber consist of non-starch polysaccharide and lignin is believed to involve physical retention, or chemical binding of the minerals to the free hydroxyl groups of cellulose polymers. Hemi cellulose and cellulose are believed to differ in their mineral binding capacity [4]. Dietary fiber consist of non-starch polysaccharide and lignin defines as cell walls of plant tissues, that are resistant to digestion, absorption in gastrointestinal tract, and are heterogeneous in terms of nutritional, chemical and physical nature [5,6]. However, such activity has been attributed to groups such as uronic acid in hemicelluloses and pectin, and phenolic groups in lignin, giving mineral binding properties to fibers [7]. The hydroxyl groups of cellulose may partially substitute for the water of hydration of Zn^{2+} ions. It might be that the un-substituted uronic acid residues of hemicelluloses and pectin are most likely involved acting as cation exchangers, and thus maybe binding bivalent metal ions. Cellulose is not likely to be involved because of its inert nature [7]. Insoluble dietary fiber could be increases the movement of luminal contents, it has not been shown yet that it affects mineral absorption [8]. The other mechanism involved insoluble dietary fiber, acting as chelators by holding numerous metal ions, preventing their absorption [9,10]. Thus, cellulose of low-affinity binding sites that can weakly bind (retain) Fe^{2+}, in conversely there have been a possible adsorption of Fe^{2+} to the cellulose surface [11,12]. In the complexes methoxy and hydroxyl groups of lignin act as ligands [11], and adsorption isotherms of Cu^{2+} and Zn^{2+} bound to lignin, and depend on the nature of the lignin [13]. Other way, iron binding by acid detergent fiber (ADF), which is composed of mainly cellulose and lignin, is largely due to cellulose and cellulose has a nonspecific, weak iron binding capacity [11]. Those that binding by lignin high affinity sites bound Fe^{2+} more than $Cu^{2+}$and Zn^{2+}. Other, studies have shown that cellulose doses not influence the absorption of Fe^{2+}, Ca^{2+}, Mg^{2+}, Cu^{2+}, or Zn^{2+}. Hemicellulose has also reported to inhibit mineral absorption, in each species [14]. Cellulose significantly bound dietary Cu and Zn. Xylan was found to negligibly influence mineral bioavailability [15]. Diet rich in dietary fiber, mainly the insoluble fraction, is associated with decreased mineral absorption, especially divalent minerals [16]. The fiber-phytate-mineral relationship and tannins complex and studies have attributed depressor effects to phytate on mineral absorption, including iron as the essential element most affected by phytate [17,18]. Mineral elements from cereals are principally located in the outer layers of the kernel and bound to cell wall components, such as lignin or phytate [19]. Thus, binding capacity of wheat bran was primarily attributed to water-soluble dietary components, while cellulose, starch, hemicelluloses, lignin, pectin, showed that lignin and pectin had high metal binding capacities [20,21]. Diet rich soluble fiber were effects on magnesium, iron and zinc retention, this could be by solubilising this element [22]. Wheat bran an inhibitory effect on mineral absorption [10,23-27]. Baker and Halpin [28] they were concluded that mineral utilization was markedly reduced by feeding the high-fiber, high-phytate supplements [29]. Phytate not only does reduce P availability, but also decreases the absorption of elements such as zinc, iron, calcium and magnesium [30]. Dephytinized of the barns' insoluble fiber fraction bound Cu^{2+}, Ca^{2+} and Zn^{2+} ions, and increased the binding capacity of Ca^{2+} and Zn^{2+} of the insoluble fiber fraction from rice bran [31]. Hassani [32] reported that rice had the highest zinc binding capacity, and binding capacity for magnesium was much lower than copper and zinc. This could be due to electronic configuration of Mg, Cu, and Zn. Zinc and copper are in the transition group of periodic table, and they need less energy to complete their outer shell. Because, magnesium required more energy to complete its outer electronic shell, and probably that is why Mg binds less. In addition the hydration shell around Mg makes it less susceptible to interaction. The aim of the present investigation was to study the effect of cell wall content of wheat bran and rice bran on biological relative bioavailability value of minerals binding that supplementation in the broilers diet.

Materials and Methods

Experimental design

The experiment was carried out in a randomized design (CRD) with 120 broiler chicks (Ross 308) for 4 repetitions (6 birds per each replicated) on the 5 treatments diet in metabolic cages. In which the birds were fed the experimental diets for 18-42 days and water was offered ad libitum. The experimental diets contain one control diet and 4 diets were formulated, basal diet containing 25% wheat bran and rice bran that supplemented with multi-enzyme contained 1000 unit phytase and 180 unit multi-glycanase activities per each gram (Table 1). Animals was followed, and the project was approved by the Animal Experimentation Ethics Committee (CETEA) of the Federal University of Minas Gerais, (protocol number 111/2009).

Statistical analysis

The data were analyzed by the General Linear Models (GLM) procedure (SAS Inst. Inc., Cary, NC). Relative bioavailability values were determined using basal diet as the standard source by slope ratio comparisons [33,34]. Differences among sources were determined by differences in their respective regression coefficients. Duncan's multiple range test were used to compare each experimental group with the control group of means ($P<0.05$).

Mineral relative bioavailability value (RBV) (Biological availability)

The relative bioavailability value (RBV) was calculated by establishing the relationship between the angular linear coefficient obtained for the non–starch polysaccharides, source (experimental group), and the linear coefficient referring to the control diet (basal diet without non-starch polysaccharide source) obtained from the linear regression analysis. The reference standard was considered equal to 100%, and the non-starch polysaccharide source RBV in the presence of NSP wheat bran and rice bran was calculated. For determined a biological apparent Ilea digestibility of diets with non-starch polysaccharide content were used chromic oxide (Cr_2O_3) with included at 0.3% in all diets as indigestible marker. Whole ideal digest were individually collected, and measured for Cr_2O_3 and mineral concentration. Apparent ideal mineral digestibility in experimental diets was calculated using the following equation.

$$AIMD = 1-[(\text{Dietary } Cr_2O_3 \text{ Cont./Fecal } Cr_2O_3 \text{ Cont.}) \times (\text{Fecal mineral Cont./Dietary mineral Cont.})]$$

AIMD = Apparent Ilea minerals Digestibility. Means of 4 observations were considered to statistical analysis.

Collection and processing of samples

During the 3rd week of the trial (21-42 days), food intake and total droppings output were measured quantitatively per cage over 4 consecutive days for the determination of AIMD. The droppings were collected daily, dried overnight at 80°C in a forced-draft oven and collections from each cage were pooled for analysis. At the end of the trial (42 days), all surviving chicks were killed by intracranial injection of sodium pentobarbitone and the small intestine was immediately exposed. The contents of the lower ileum were expressed by gentle flushing with distilled water into plastic containers. The ileum was defined as that portion of the small intestine extending from the vitelline diverticulum to a point 40 mm proximal to the ileo-caecal junction. The ileum was divided into 2 halves and the digesta were collected from the lower half towards the ileo-caecal junction. The digesta samples were frozen immediately after collection and subsequently emicellulo. Dried droppings and ileal digesta samples were ground to pass through a 0.5 mm sieve and stored at -4°C until chemical. Examination of minerals concentrations from sources by the ashed solution were then analyzed by using a flame atomic absorption spectroscopy as described by AOAC (1990) (Spectro AA, VARIAN). Total, insoluble and soluble dietary fiber and non-resistant starch were determined by using Megazyme assay kits (Megazyme International Ireland Ltd., Wicklow, Ireland) according to Approved Methods of the American Association of Cereal Chemists (AACC, 2000). Data were reported on a dry weight basis.

Results and Discussion

The results of the analyses for nutritive value of wheat bran and rice bran used in the experiment are presented in Table 2. The nutritive value as crud protein, crud fiber, ether extract, crud ash and total carbohydrate content, NDF, ADF, ADL, NSP, of both wheat and barley are in Table 2.

Cellulose content was calculated by difference: ADF – ADL.

Hemicelluloses content was calculated by difference: NDF – ADF.

Total carbohydrate (CHO): [100 – (protein + fat + moisture + ash)].

Un-Soluble Dietary Fiber (USDF), Soluble Dietary Fiber (SDF)

Non-Starch Polysaccharide (NSP) = Dietary Fiber + Lignin

Non Fiber Carbohydrate is calculated (NFC) by difference [100-(%NDF + %CP + %Fat + Ash)].

Data presented that enzyme supplementation had effect on increase biological apparent Ileal digestibility values minerals of cell wall consist of non-starch polysaccharide and lignin from diets content wheat bran and rice bran (Tables 3 and 4). Also wheat bran and rice bran were relatively high P digestibility. This can be attributed to the phytase enzyme role that relays play of P in the phytate content of wheat bran and rice bran of diet to improve the apparent Ileal digestibility of P element. Because, P present in phytate is largely unavailable and phytic acid and phytate can chelated with other elements, thus decreases the absorption of elements such as zinc, iron, calcium and magnesium [30,35,36]. The phytase effect on P availability has been well documented [37,38]. Other way, by dephytinized, the brans' insoluble fiber fraction bound Cu^{2+}, Ca^{2+} and Zn^{2+} ions, and increased the binding capacity of Ca^{2+} and Zn^{2+} of the insoluble fiber fraction from rice bran [31].

Ingredients	Basal diet	Wheat Bran*	Rice Bran*
Yellow corn	64.00	46.6	42.80
Soy bean meal	29.29	20.44	24.50
Soy oil	3.50	5.20	4.5
Wheat Bran	-	25	-
Rice Bran	-	-	25
DCP	1.81	1.107	1.15
Calcium Carbonate	0.8	1.0	1.0
Sodium Chloride	0.14	0.3	0.2
DL-Methionine	0.05	0.14	0.08
L-Lysine HCL	0.01	0.22	0.02
Vitamin Premix**	0.20	0.25	0.25
Mineral Premix**	0.20	0.50	0.50
Total	100	100	100
Calculated values			
MEn (Kcal/Kg)	3200	2950	2970
Protein (%)	19	17.74	17.19
Met+Cys (%)	0.85	0.85	0.84
Lysine (%)	1.2	0.82	1.11
Calcium (%)	0.95	0.87	0.85
Available Phosphorus (%)	0.45	0.43	0.42
Mn mg/kg	31.86	79.24	84.68
Zn mg/kg	26.02	64.76	62.34
Sodium (%)	0.15	0.14	0.16
Chloride (%)	0.22	0.23	0.23
Potassium (%)	0.87	0.88	0.88
(Na+K)-Cl (meq/kg)	231.23	231.54	231.54
NSP Determination	0.87		
Total NSP (%)	231.23	24.05	20.58
NSP Estimation			
Total NSP (%)	-	18.25	15.84
Soluble NSP (%)	-	2.43	2.05
Non-Soluble NSP (%)	-	16.03	12.79

*Supplemented with exogenous enzyme included 1 kg per 1000 kg of diet for all treatments and contained 1000 active units of Phytase and 180 active units of multi-glycanase units per gram

**Provided per kilogram of diet: Vitamins: 44000 IU A, 17000 IU D3, 440 mg E, 40 mg K3, 70 mg B12, 65 mg B1, 32 mg B2, 49 mg Pantothenic acid, 122 mg Niacin, 65 mg B6, 22 mg Biotin, 27 mg Choline Chloride, and Minerals: 99.20 mg Mn (MnO), 85 mg Zn (ZnO), 50 mg Fe ($FeSO_4$), 10 mg Cu (Cu $SuSO_4$), 0.2 mg Se (Na_2SeO_3), 13 mg I (KI), and 250 mg Co

Table 1: The calculated and analysis composition and nutrient content of experimental diets fed to broilers chickens (42 days).

Rice Bran	Wheat Bran	Nutritive value
93.52	90.45	Dry Matter
9.62	15.7	Crude Protein
27.86	11.05	Crude Fiber
5.37	1.97	Ether Extract
15.63	4.6	Ash
66.60	45.4	NDF
44.8	13.8	ADF
11.20	4.2	ADL
69.38	77.73	CHO
33.60	9.60	Cellulose
21.80	31.60	Hemicelluloses
25.5	37.40	Total Dietary Fiber
0.5	2.90	SDF
21.3	35.90	USDF
35.07	44.90	NSP
2.78	32.53	NFC

ADL: Acid Detergent Lignin; NAF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber

Table 2: Nutritive values of wheat bran and rice bran used in experiments (%).

SE	P values	RB+Enzyme	RB	SE	P values	WB+Enzym	WB	Minerals
0.024	0.001	0.39 ± 0.06[a]	0.29 ± 0.06[b]	0.02	0.08	0.37 ± 0.01	0.35 ± 0.01	Ca
0.05	0.1	0.34 ± 0.03	0.33 ± 0.03	0.02	0.35	0.54 ± 0.12	0.44 ± 0.07	P
0.05	0.001	0.64 ± 0.03[a]	0.42 ± 0.09[b]	0.07	0.08	0.40 ± 0.01	0.37 ± 0.12	Cu
0.04	0.1	0.46 ± 0.00	0.26 ± 0.04	0.03	0.51	0.43 ± 0.04	0.36 ± 0.04	Mn
0.03	0.001	0.56 ± 0.00[a]	0.28 ± 0.01[b]	0.05	0.06	0.49 ± 0.01	0.39 ± 0.06	Fe
0.018	0.001	0.29 ± 0.00[a]	0.13 ± 0.01[b]	0.001	0.54	0.17 ± 0.01	0.17 ± 0.07	Zn

[a]Diets included 25% wheat bran with 24/02% total NSP

[b]Diet included 25% Barley with 20/58% total NSP

Table 3: Effect of enzyme supplementation on biological apparent Ileal digestibility (g/100 g) of diets included wheat bran and rice bran for broiler chickens (42 days old).

RB+Enzyme	RB	WB+Enzym	WB	Minerals
14.28 ± 0.09	13.26 ± 3.16	14.31 ± 0.68	13.08 ± 0.09	Ca
6.21 ± 0.03	5.89 ± 0.88	6.50 ± 0.46	5.68 ± 0.59	P
16.65 ± 2.55	13.90 ± 3.70	16.95 ± 1.95	14.10 ± 1.50	Mn
420.65 ± 18.85	406.70 ± 35.10	426.70 ± 87.40	388.35 ± 8.25	Fe
174.75 ± 2.85	168.70 ± 36.80	172.65 ± 7.35	155.45 ± 13.25	Zn

Table 4: Effect of dietary cell wall consist of non-starch polysaccharide and lignin content of wheat bran and rice bran on tibia minerals concentration (42 days).

The minerals concentration of tibia bone of diet content of cell wall consist of non-starch polysaccharide and lignin from wheat bran and rice bran and supplementation with enzyme are shown in Table 5. The tibia bone mineral concentration of diets included wheat bran and rice bran that supplementation with enzyme were increased but not significantly differences. Data shown those that bone is able more retention calcium and Mn compare to other minerals [39].

Results mean values of tibia bon quality characteristics as weight, length, diameter, bone volume, bone density and seedor index (SI) of cell wall consist of non-starch polysaccharide and lignin from wheat bran and rice bran of chickens were presented in Table 5. Data shown those cell wall consist of non-starch polysaccharide and lignin were effected on bon quality characteristics and seedor index tibiae respectively ($P<0.05$). This similar to that, Onyango et al. [40] reported that birds where fed minerals (Zn, Mn, Cu) diet showed improved tibia weight, length, diaphysis diameter, weight/length index and tibia robusticity index. Result of tibiae bone volume value shown significantly differences in the effect of both cell wall consist of non-starch polysaccharide and lignin sources ($P<0.05$), this result is consistent with Garlich et al. [41]. Data of our experiment had shown that cell wall consists of non-starch polysaccharide and lignin sources did not effect on tibia mineral density. Zhao et al. [42] who reported that broilers fed diets supplemented with Zn, Mn, and Cu had no effect on tibia strength. Seedor et al. [43] and Riesenfeld [44] used the bone weight/bone length index and the robusticity index, respectively, and simple index of bone density to describe bone mineralization. The Seedor index values were significantly differences for both cell walls consist of non-starch polysaccharide and lignin sources, as values ranged from 58/31 for wheat bran to 56/08 for rice bran [45]. However, result of experiment indicted that enzyme supplementation have been improve the Seedor index values for both cell wall sources (58/31 to 65/20 for wheat bran and 56/08 to 64/38 for rice bran). Although, enzyme supplementation have increased ash values, but were not significantly differences. But, in contrast to Geraldo et al. [46]

Sig. level	RB+Enzyme	RB	WB+Enzym	WB	Characteristics
*	6.67 ± 0.93	5.26 ± 0.82	6.87 ± 1.44	5.40 ± 0.51	Weight (g)
*	10.36 ± 0.19	9.38 ± 0.18	10.54 ± 0.65	9.26 ± 0.80	Length (cm)
*	7.55 ± 0.93	8.46 ± 0.04	6.74 ± 0.37	6.73 ± 0.09	Diameter (mm)
*	10.00 ± 1.00	8.25 ± 0.75	10.00 ± 2.00	8.00 ± 0.00	Bone volume (cm3)
ns	0.66 ± 0.02	0/63 ± 0/04	0.68 ± 0.006	0.67 ± 0.06	Bone density (g/cm3)
*	64.38 ± 0.05	56.08 ± 0.04	65.20 ± 0.006	58.31 ± 0.007	SI*
ns	35.84 ± 1.79	31.82 ± 1.69	35.89 ± 0.68	33.08 ± 0.72	Ash%
*Seedor Index					

Table 5: Mean values of bon quality characteristics, bone mineral density (BMD), Seedor index (SI) and ash content (DM) of the tibia for broiler chickens.

Linear regression of tibia minerals concentration added dietary cell wall source from the wheat bran and rice bran resulted in equation with liner model. Relative bioavailability estimates of cell wall consist of non-starch polysaccharide and lignin source based on linear regression slope for tibia bon concentration are found in Tables 6 and 7. Relative bioavailability values minerals of wheat bran Ca, P, Mn, Fe, and Zn were 140.75, 55.78, 79.53, 69.84 and 58.76 based on tibia bon respectively (Table 8). Thus, relative bioavailability values of tibia minerals of rice bran Ca, P, Mn, Fe, and Zn were 125.70, 67.06, 15.53, 17.25 and 11.47 respectively (Table 9). Zinc and Fe unlike Ca, P and Mn absorption in the intestinal lumen to tibia retention [47,48]. The reason of these differenced may be various solubility of minerals are content of cell wall content from rice bran source, and may be a limited of different molecular weight ligands of cell wall content of rice bran for bonding minerals [49].

According the result of data the retention of each mineral in tibia bon was not constant and variation for cell wall consist of non-starch polysaccharide and lignin sources. Other way, retention of each mineral in tibia more sensitivity to dietary source as wheat bran and rice bran. Tibia minerals have come to be recognized as the variables of choice in calculation of relative bioavailability value [50-52]. These variable responses on the cell wall consist of non-starch polysaccharide and lignin source were used to calculate RBV of mineral in wheat bran and rice bran based diets. Based on tibia minerals, RBV were calculated as follows:

RBV = (Tibia minerals – Y intercept) × 100/(slope of regression line relating tibia minerals × minerals intake)

Regression coefficient		Relative Bioavailability Value (RBV)	
Slope	SE		Minerals
4.49	5.59	140.750	Ca
4.20	3.41	55.78	P
554.68	32225	79.53	Mn
57.34	5306	69.84	Fe
16015	11339	58.76	Zn

Table 6: Regression coefficient and Relative Bioavailability Value (RBV) of bone minerals in wheat bran.

Regression coefficient		Relative Bioavailability Value (RBV)	
Slope	SE		Minerals
4.029	3.50	125.70	Ca
5.05	4.92	67.06	P
108.37	167.12	15.53	Mn
14.16	23.48	17.25	Fe
31.285	18.52	11.47	Zn

Table 7: Regression coefficient and Relative Bioavailability Value (RBV) of tibia bone minerals from rice bran.

According the result of data the retention of each mineral in tibia bon was not constant and variation for cell wall consist of non-starch polysaccharide and lignin sources. Other way, retention of each mineral in tibia more sensitivity to dietary source as wheat bran and rice bran. Tibia minerals have come to be recognized as the variables of choice in calculation of relative bioavailability value [50-52]. These variable responses on the cell wall consist of non-starch polysaccharide and lignin source were used to calculate RBV of mineral in wheat bran and rice bran based diets. Based on tibia minerals, RBV were calculated as follows:

RBV = (Tibia minerals – Y intercept) × 100/(slope of regression line relating tibia minerals × minerals intake)

By used this method, the Relative Bioavailability Value (RBV) of minerals in wheat bran and rice bran were significantly difference for both for cell wall consist of non-starch polysaccharide and lignin source except Ca and Mn values (Table 8) (based reference diet = 100). The apparent retention or RBV in tibia of minerals in wheat bran and rice bran ranged from Ca 9.50 to 11.06, P14.56 to 11.26, Mn 0.26 to 0.86, Fe 2.32 to 7.7 and Zn 1.57 to 2.18% receptivity. These differences may be depended to mechanisms physico-chemical properties of dietary cell wall consist of non-starch polysaccharide and lignin in mineral binding are the cation exchange capacity, and compound absorptive properties [3,53]. While insoluble fiber fraction [54].

P-value	MSE	Rice Bran	Wheat Bran	Minerals
ns	2.96	11.06^{c}	9.50^{c}	Ca
-	1.46	11.26^{b}	14.56^{a}	P
-	0.04	0.86^{a}	0.26^{b}	Mn
-	0.41	7.7^{a}	2.32^{b}	Fe
ns	8.43	2.18^{b}	1.57^{b}	Zn

Table 8: Relative Bioavailability Value (RBV) of tibia bone minerals on broiler chickens^{a-c}.

Regression coefficient		Relative Bioavailability Value (RBV)	
Slope	SE		Minerals
0.13	0.023	50.00	Ca
0.10	0.19	28.57	P
0.0002	0.00009	1.82	Cu
0.00051	0.00034	42.50	Mn
0.00024	0.00014	46.15	Fe
0.0004	0.00012	30.77	Zn

Table 9: Regression coefficient and Relative Bioavailability Value (RBV) of wheat bran.

Relative bioavailability values of cell wall consist of non-starch polysaccharide and lignin source based on slop ratio of wheat bran for minerals concentrations are present on Table 9. Linear regression relationships were observed in all minerals, so the relative bioavailability values were estimated based on them on daily dietary minerals intake. When the response to control diet was set at 100%, the estimated relative bioavailability of Ca, P, Cu, Mn, Fe and Zn were 50, 28.57, 1.82, 42.50, 46.15 and 30.77 for cell wall content of wheat bran respectively. The result of experiment agrees with Camire and Clydesdale [21], that suggested the cell wall of wheat bran can influence of binding of some minerals. Because, hemicellulose and cellulose are to differ in their mineral binding capacity [4], and ion exchange resin in the lower gastrointestinal such as uronic acid in hemicelluloses and pectin, and phenolic groups in lignin, giving mineral binding properties to fibers [7,10]. Other way in contrast, Claye et al. [55] that he reported total dietary fiber bound more Cu, and hemicelluloses, lignocelluloses and lignin bound more Zn. The reduction in mineral bioavailability in birds when fed diets with cereals rich in fibers [10,56] has been associated with their fiber or cell wall content and with the amount of phytic acid which is also implicated in lowering cations bioavailability [10,57,58]. Vanhouny et al. [23] has been suggested that wheat bran an inhibitory effect on mineral absorption [10,24-26], and decreases the absorption of elements such as zinc, iron, calcium and magnesium [30,31] and Fe [27].

Estimated of the relative biological availability were obtained by ration of the slopes from the linear regression equations (Table 10). When the slope of regression control diet was set equal to 100%, relative bioavailability values of 30.78, 71.43, 0.64, 91.67, 96.15, and 138.46 were obtained for Ca, P, Cu, Mn, Fe and Zn respectively, based on cell wall consist of non-starch polysaccharide and lignin source from rice bran. The result of experiment indicated that Zn, Fe, Mn and P were highly relative bioavailability values with respect to amount of cell wall content of rice bran respectively. These results agree to Ghodrat et al. [56] who's indicted that rice bran had highest mineral-binding capacity in small intestine for Mn, Zn, and Cu [20,21]. Also, in similar study, Hassani [32] that reported rice had the highest zinc binding capacity. Because, hemicelluloses and cellulose are to differ in their mineral binding capacity [4,19]. Contrary to those findings, Platt and Clydesdale [11] indicated that cellulose has a nonspecific, weak iron binding capacity [14,15]. Because, our study indicated that Cu and Ca elements were have less relative bioavailability values. Thus, published research reported that minerals bioavailability of cereals less or poorly utilized than from animal sources by monogastric animals. Endogenous and exogenous factors have been implicated in reduction of minerals absorption from lignin act as ligands in cereals [11,53,59] and depend on the nature of the lignin [13].

Regression coefficient		Relative Bioavailability Value (RBV)	
Slope	SE		Minerals
0.08	0.076	30.78	Ca
0.25	0.20	71.43	P
0.00007	0.0004	0.64	Cu
0.0011	0.0008	91.67	Mn
0.0005	0.0003	96.15	Fe
0.002	0.0012	138.46	Zn

Table 10: Regression coefficient and Relative Bioavailability Value (RBV) of rice bran.

Conclusion

In conclusion, the present data demonstrated that the enzyme supplementation had effect on increase biological apparent Ileal digestibility values minerals as Ca, P, Mn, Fe, and Zn of diets content wheat bran and rice bran. Under the conditions of the present study, wheat bran and rice bran were relatively high P digestibility. This can be attributed to the phytase enzyme role that relays play of P in the phytate content of diet to improve the apparent Ileal digestibility of P element. Thus, data shown that cell wall consists of non-starch polysaccharide and lignin source were affected on bon quality characteristics and seedor index tibiae respectively. However, Relative Bioavailability Values (RBV) minerals for wheat bran as Ca, P, Mn, Fe, and Zn were 140.75, 55.78, 79.53, 69.84, 58.76; and rice bran also, 125.70, 67.06, 15.53, 17.25 and 11.47 based reference diet=100%, respectively. Furthermore, by used other method, for determined RBV of minerals in wheat bran and rice bran were significantly difference for both cell walls consist of non-starch polysaccharide and lignin sources.

The present study shown that relative bioavailability values (biological availability), of minerals concentrations of wheat bran and rice bran as cell wall consist of non-starch polysaccharide and lignin source sources based on slope of regression response to control diet was set equal to 100%, on them on daily dietary minerals intake were estimated. Under the conditions of the present study, linear regression were used for the estimated relative bioavailability value of Ca, P, Cu, Mn, Fe and Zn content of wheat bran and rice bran as cell wall consist of non-starch polysaccharide and lignin sources. Overall, relative bioavailability values were 30.78, 71.43, 0.64, 91.67, 96.15 and 138.46 for rice bran, as well; values of wheat bran are 50.00, 28.57, 1.82, 42.50, 46.15, and 30.77, respectively. The result of experiment indicated that Zn, Fe, Mn and P from rice bran, as well as, Ca, Mn, and Fe for wheat bran were have highly relative bioavailability values, with respect to amount of cell wall consist of non-starch polysaccharide and lignin sources.

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