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Evaluation of Soya Bean Meal on Growth Performance and Packed Cell Volume (PCV) of Albino Rat (*Rattus Norvegicus*)

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ABSTRACT

With regards to soya bean meal in the feed consumed by livestock, this research was carried out to evaluate soya bean meal on weight gain and their Packed Cell Volume (PCV). Ten albino rats (Rattus norvegicus) were used and were divided into two groups. Group I serves as the experimental and was fed with 10g of soya bean meal mixed with 100g of chick's mash. Group II serves as the control and was fed with 100g of chick's mash. Both groups were allowed access to drinking water. The experiment lasted for five weeks and statistical analysis (ANOVA) was used to determine the effect of soya bean meal. The result showed that there was a significant increase in the mean weight of rats in the experimental group than that of the control group. Thus, the mean weight of the experimental group was 152.36g and that of the control is 134.60g. The mean PCV of group I was 23.80% and that of group II was 17.16%. There was a significant difference ($p < 0.05$) in the PCV of rats fed with soya bean meal inclusion and the control group. Soya bean meal was also found to have a significant effect ($P > 0.05$) in the increased weight of the albino rats in the experimental group. The inclusion of soya bean meal was found to increase the palatability and the ability of the experimental animal to fully utilize the feed as such, it is highly recommended for livestock farming.

Keywords: Soya bean meal (SBM), Albino rats, Packed cell volume (PCV), Growth performance

INTRODUCTION

Soya bean *(Glycine max)* is a leguminous plant which is widely known for its high protein content and rich source of edible vegetable oil [1]. Soya bean has become a primary source of human food and a major anti-dote to the acute deficiency of protein in the sub-humid and humid tropics where a large population of the world's

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population live [2]. Soya bean meal (SBM) is a solid residue by-product (flour), created after grinding the soya bean to extract soya bean oil. It is widely used as filler and source of protein in animal diets, including pig, cattle, livestock, horse, sheep and fish feed. Commercial soya bean meal is usually yellow or yellowish-brown in colour [3]. There are different types of soya bean meal products used for animal feeding and these include: solvent extracted, soya protein isolate, mechanically extracted, and fermented soya. The idea behind the various types of treatment applied to soya bean seed is to neutralize the effect of anti-nutrients present in these seeds and to improve the palatability, flavour and digestibility of soya bean meal products for animal consumption and utilization.

Albino rats (*Rattus norvegicus)* is the most commonly used laboratory mammal, accounting for approximately 20% of the total number of mammals used for scientific purposes [4]. In almost every aspect of biomedical and behavioral research Albino rats have been utilized for investigation. The following areas of biomedical investigation have been listed as ones in which the rat is widely used and particularly useful: toxicology, immunology, dental research immunogenetics, endocrinology and experimental parasitology [5]. To determine the effect of soya bean meal on the packed cell volume of albino rats and their weight gain, the haematocrit would be evaluated using the haematocrit reader. The haematocrit (Ht or HCT) also known as Erythrocyte Volume Fraction (EVF) or Packed Cell Volume(PCV) is the volume of red blood cell in blood [6]. It is usually about 45% for men and 40% for women. It is an integral part of a person's complete blood count results, along with haemoglobin concentration, white blood cell count, and platelet count. In mammals, haematocrit is dependent of body size [6,7]. According to Wikipedia (2013) the term haematocrit was modeled after the word Lactokrit which is used in dairy farming. This research is aimed at Assessing the growth performance and the packed cell volume of albino rats (*Rattus norvegicus*) Fed with soya bean meal, to determine the effect of soya bean meal in the feeds consumed by livestock.

Literature

Soya Bean Meal contains highly digestible amino acid content for farm animals. There are different types of soya bean meal products used for animal feeding and these include: solvent extracted, soya protein isolate, mechanically extracted, and fermented soya [8]. Like most oil seed meal, soya bean meal contains anti-nutritional factors such as: protease inhibitors, phatic acids, allergens, lectins, antivitamins, phytoestrogens. These chemical substances are used by plants for self defence against foreign organisms [9]. To improve the palatability, flavour and digestibility of soya bean meal products for animal consumption and utilization, various types of treatment are applied to soya bean seed to neutralize the effect of anti-nutrients present in these seeds [8]. Soya bean meal can be processed by dry heating, moist heating (toasting) or without heat [8,10]. Proper processing (heating) of soya bean meal is very important to aid digestibility of protein and its amino acids. Also quality of soya bean meal protein is determined through the *in-vitro* assessment of the soya bean protein for livestock consumption. The three standard methods employed for *in-vitro* assessment of the soya bean protein, includes; urease test, protein dispersibility index (PDI) and protein solubility methods [11]. The methods of

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processing soya bean seed varies and it's dependent on the intended product, level of oil expected in the product and the class of the targeted farm animals [12].

Like other farm animals such as pigs, rats are omnivores and feed on variety of items from carcasses to fallen fruits [13]. They can take advantage of many food sources within the environment, ranging from garbage cans, open containers of food, pet food bowls and will even cannibalize themselves [13]. Laboratory rat breeding experiments were first reported from Germany where they were used for neurological studies [14]. The Albino rats (*Rattus norvegicus)* also known as the Norway rat [15], have been the animal of choice in much nutritional research [4]. Although it should be noted that their natural habit of coprophagy may limit their suitability for certain studies [5]. Typical albino rat has short hair, a long naked tail, rounded erect ears, protruding eyes, a pointed snout with long vibrissae, five toes on each foot, poor eye sight and depend on the vibrissae and olfaction for sensory input [16]. There is an overgrowth of the incisors of upper and lower teeth, and when they do not meet properly, this leads to condition known as malocclusion [17]. Brown fat is diffusely distributed over the dorsal, ventral, and lateral aspect of the neck and at the pelvis of the kidney, Producing a gland-like appearance in the inter-scapular region know as the hibernating gland [18]. The gland plays a significant role in thermo genesis which makes the rat suitable for cold adaptation studies. Like other rodents, albino rat's stomach has a large glandular portion or fore stomach, making up over 1/3 of the total gastric mucosa. The glandular stomach has no cardiac glands and is rich in histamine-producing gastric mast cells. The large caecum aids in the digestion of the cellulose depending on the size, a rat needs 60 calories a day and will eat 15g of dry food a day [19]. Lab-block is a complete nutritional diet that meets the nutritional requirements of rats coupled with clean fresh water, and on average an adult rat water intake is 10 ml per 100mg body weight [13]. Digestible protein nutrient as opposed to crude protein is relatively easy for rat to absorb [20].

Nutrients diffuse into the blood stream [21] and the blood samples are taken to determine the dietary effects of the consumed nutritional diet [22,26]. This is done through calculation of the Pack cell volume (PCV). Packed cell volume or haematocrit can be determined by centrifuging heparinized blood in a capillary tube, 10,000 RPM for five minutes. This separates the blood into layers. The volume of the packed red blood cell divided by the total volume of the sample gives the PCV [22]. Calculation can be done manually, through direct measurement of the length of layers when a tube is used, or through the use of automated analyzer [22,7].

MATERIALS AND METHODS

The study was carried out at the animal house of the Zoology department, Faculty of Biological Sciences, Nnamdi Azikiwe University, Awka in Awka South Local Government, Anambra State, Nigeria. The albino rats were purchased from Department of Radiography, faculty of health sciences, Nnamdi Azikiwe University, Okofia Campus. The rats were 4 males and 6 females. Soya bean seeds were purchased from the local market in Nnewi, in Nnewi North Local Government, Anambra state, Nigeria. The soya bean seeds were cleaned by removing stones, dirt, and dried

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using an aspirator. The dried clean seeds were milled and sieved to pass through a 0.5 mm mesh, and kept in airtight plastic container. Chick's mash (Top feed) were purchased from Eke Awka market in Awka South Local Government, Anambra state.

The animals were separated into two groups, five animals in each group. **Group I** was experimental group; the rats in this group were fed with 10g of soya bean mixed with 100g of chick's mash. **Group II** was the control; the rats in this group were fed with 100g of chick's mash. All animals were allowed access to water throughout the research period which lasted for six weeks with one week of acclimatization. The site was visited every morning to ascertain the progress of the study. The cages were cleaned on weekly basis to reduce the risk of infection and also animals were checked on daily basis of injury inflicted by one another in the course of aggressiveness. The feeding and drinking troughs were also washed on daily basis. There was no breeding throughout the period of the experiment; however signs of sexual display were noticed.

The weights of the animals were recorded on the weekly basis with a sensitive balance to determine the gain in weight. The blood samples of the animals were collected on the weekly basis to ascertain the PCV. The blood samples were collected from the tip of the tail into a capillary tube. This was done by making an incision at tip of the tail using a sharp scissors. Complete homeostasis was allowed to take place before returning each rat to the cage [23]. The blood was spun using haematocrit centrifuge for five minutes. PCV of the rats were read using the haematocrit reader.

RESULTS

The result of the descriptive shows that the mean packed cell volume of the control group was 17.16% while that of the experimental group was 23.80 %, indicating that soya bean meal has a positive effect on packed cell volume of albino rats. Also the mean weight of rats from the control group is 134.60g while that of the experimental group is 152.36g which shows that the rats fed soya bean gained weight than those fed with control diet. From analysis of variance (Table 2) it was observed that there was significant difference ($P < 0.05$) in the PCV of rats fed with soya bean meal and the control group. There was also significant difference ($P > 0.05$) between the rats fed with soya bean meal and the control group in their weight gain.

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Table 1: Description of weight gain and PCV of Rats

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PVC	Control Group	25	17.16	7.487	1.497	14.07	20.25	1	30
	Experimental Group	25	23.80	6.752	1.350	21.01	26.59	12	35
	Total	50	20.48	7.812	1.105	18.26	22.70	1	35
WEIGHT	Control Group	25	134.60	48.754	9.751	114.48	154.72	1	192
	Experimental Group	25	152.36	17.687	3.537	145.06	159.66	123	182
	Total	50	143.48	37.389	5.288	132.85	154.11	1	192

Table 2: ANOVA of the effect of soya beans meal on PCV and weight

		Sum of Squares	df	Mean Square	F	Sig.
PCV	Between Groups	551.120	1	551.120	10.845	.002
	Within Groups	2439.360	48	50.820		
	Total	2990.480	49			
WEIGHT	Between Groups	3942.720	1	3942.720	2.932	.093
	Within Groups	64555.760	48	1344.912		
	Total	68498.480	49			

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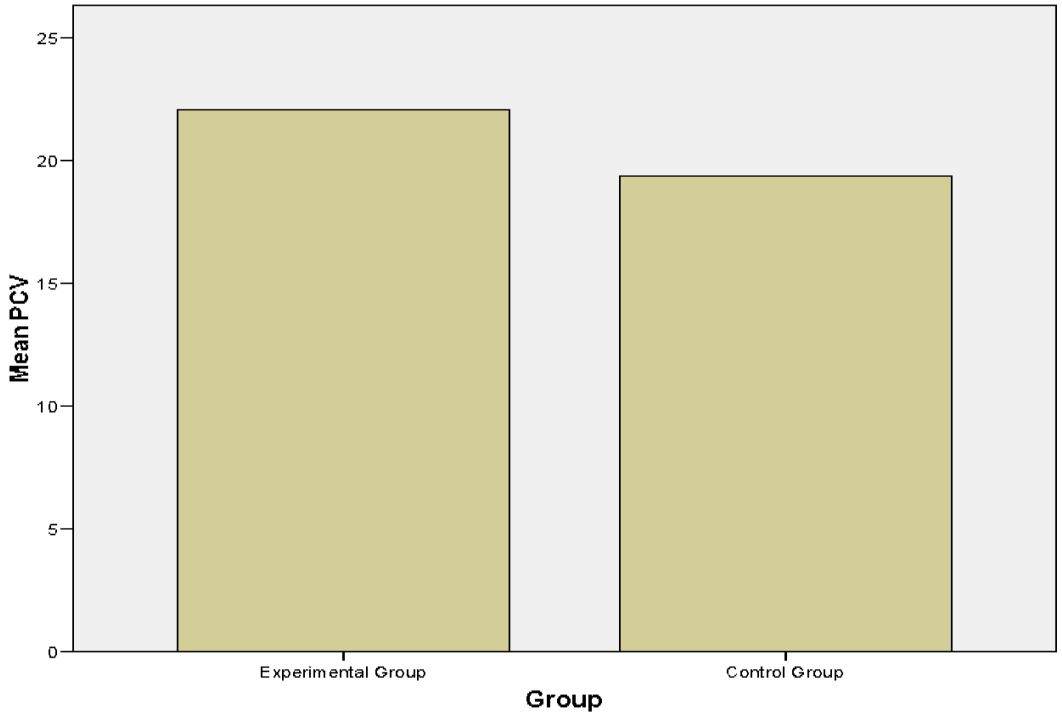

Figure 1: Bar chart of mean PCV of albino rats

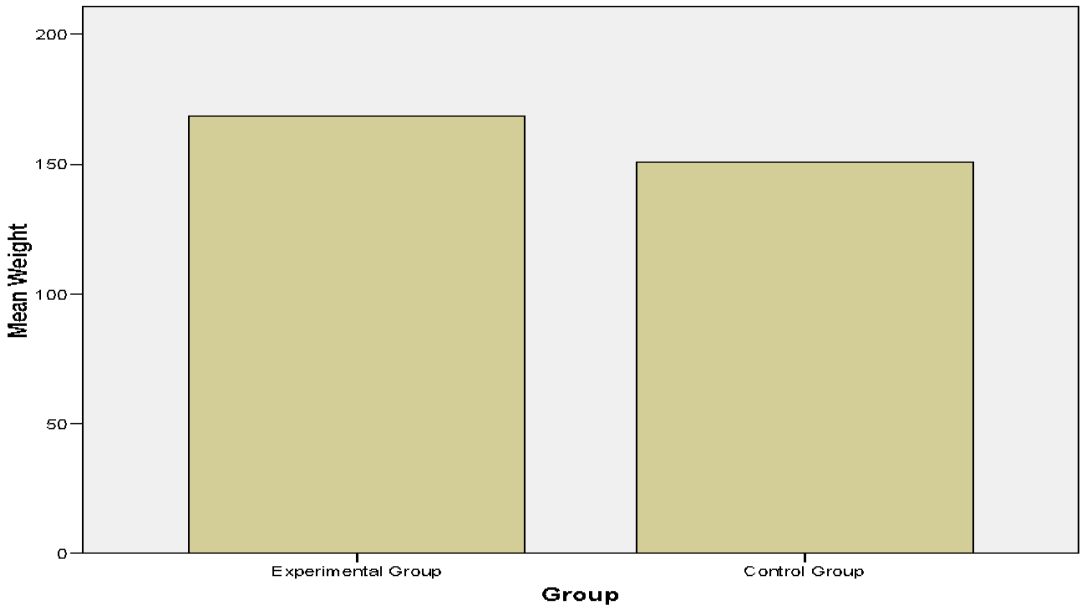

Figure 2: Bar chart of mean weight of albino rats

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DISCUSSION

The statistical analysis used was ANOVA to determine any significant change (Norman *et al.,* 1971) in the feeds consumed by the rats. As an economic crop used for both human and animal feeding, Soya bean meal is one of the most researched ingredients in animal nutrition and one of the most important feed ingredients used for feeding livestock. Albino rats were used to test the nutritional values of soya bean meal through its effect on their body weight and PCV. The rats were weighed weekly to determine the weight gain and and the blood samples collected to determine the packed cell volume. Packed cell volume (PCV) of the rats were read using the haematocrit reader.

From the study, it was observed that there was a significant difference ($P < 0.05$) in the PCV of albino rats in **group I**, that is those fed with feed mixed with soya bean meal than the rats in **group II**, that is, those fed with control diet. Thus, soya bean meal increased the PCV of albino rats. More so, soya bean meal has significant effect ($P > 0.05$) in increased weight of the albino rat; as shown by the table above, the mean weight of the albino rats in **group I** was higher than that of **group II**. This observation concurs with that of Aletor *et a*l. [2] assertion that the weights of Albino rats fed with soya bean meal mixed chick's mash tends to be higher than those fed with commercial feed. However, research by Hammond *et al*. [25] found that there were no meaningful differences in body weight, cumulative body weight gain, or food consumption between rats fed with processed soya bean meal or unprocessed ground meal. Mash diet is found to gives a greater unification of growth, more economical and less death loss in poultry [26]. As such, the occurrence of mean weight difference found by this study is likely to be as a result of the mixture of soya bean meal with the chick's mash.

CONCLUSION AND RECOMMENDATION

Due to high crude protein content of Soya bean meal, it is conceivable that its inclusion has enhanced nutritional value and may be more useful supplement to enhance protein or food value of commercial feed. With regards to weight gain, feed consumption, and feed efficiency observed in this research, feed with soya bean meal combination surpasses the commercial feed, thus it is highly recommended for livestock farming.

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APPENDIX

Table 1: Week 1

EXPERIMENTAL			**CONTROL**		
ANIMALS	**PCV (%)**	**WEIGHT(g)**	**ANIMALS**	**PCV (%)**	**WEIGHT(g)**
1	12	163	1	14	143
2	14	174	2	13	155
3	15	130	3	15	138
4	13	136	4	12	136
5	15	139	5	15	139

Table 2: Week 2

EXPERIMENTAL			**CONTROL**		
ANIMALS	**PCV (%)**	**WEIGHT(g)**	**ANIMALS**	**PCV (%)**	**WEIGHT(g)**
1	25	180	1	20	152
2	20	180	2	15	158
3	15	150	3	20	140
4	15	140	4	15	141
5	20	143	5	20	140

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Table 3: Week 3

EXPERIMENTAL			CONTROL		
ANIMALS	**PCV (%)**	**WEIGHT(g)**	**ANIMALS**	**PCV (%)**	**WEIGHT(g)**
1	34	190	1	15	160
2	30	192	2	20	162
3	20	165	3	30	145
4	25	150	4	25	146
5	20	155	5	15	143

Table 4: Week 4

EXPERIMENTAL			CONTROL		
ANIMALS	**PCV (%)**	**WEIGHT(g)**	**ANIMALS**	**PCV (%)**	**WEIGHT(g)**
1	30	201	1	20	163
2	34	198	2	25	165
3	25	180	3	30	149
4	20	158	4	20	151
5	20	161	5	25	148

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Table 5: Week 5

EXPERIMENTAL			**CONTROL**		
ANIMALS	**PCV (%)**	**WEIGHT(g)**	**ANIMALS**	**PCV (%)**	**WEIGHT(g)**
1	35	205	1	20	167
2	30	203	2	20	169
3	25	189	3	25	154
4	20	165	4	20	157
5	20	168	5	15	152

REFERENCES

1. Aletor O., (2010). "Nutrition and physio-chemical characteristics of some plant and animal-based protein concentrates. *International Journal of Chemical Sciences.*Nassarawa, 2(2): 155-165
2. OA, . JOA, . SAA, . VAA. Chemical and Physio-Chemical Characterization of the Flours and Oils from Whole and Rejected Cashew Nuts Cultivated in Southwest Nigeria. Pakistan Journal of Nutrition [Internet]. Science Alert; 2007 Jan 1;6(1):89–93. Available from: http://dx.doi.org/10.3923/pjn.2007.89.93
3. Aletor VA, Egberongbe O. Feeding differently processed soya bean Part 2. An assessment of haematological responses in the chicken. Food / Nahrung [Internet]. Wiley; 1992;36(4):364–9. Available from:http://dx.doi.org/10.1002/food.19920360406
4. Aletor VA, Egberongbe O. Feeding differently processed soya bean Part 2. An assessment of haematological responses in the chicken. Food / Nahrung [Internet]. Wiley; 1992;36(4):364–9. Available from:http://dx.doi.org/10.1002/food.19920360406
5. Baker, H.J., Lindsey, J.R. and Weisbroth, S.H.(eds*).(1980) The Laboratory Rat.* vol II.154-168. Research Application, Academic Press, NewYork.
6. Baker, H.J., Lindsey, J.R. and Weisbroth, S.H.(eds*).(1980) The Laboratory Rat.* vol II.154-168. Research Application, Academic Press, NewYork,
7. Wikipedia (2013). Packed Cell Volume. Available at: en.wikipedia.org/wiki/packed_cell_volume.
8. Lusas, E.W. and Riaz, M.N.(1995). "Soya Protein Products and Use J. Nutrition122:5735-5805

ISSN 2047-9093

9. Francis G, Makkar HP., Becker K. Antinutritional factors present in plant-derived alternate fish feed ingredients and their effects in fish. Aquaculture [Internet]. Elsevier BV; 2001 Aug;199(3- 4):197–227. Available from:http://dx.doi.org/10.1016/s0044-8486(01)00526-9
10. Vasconcelos IM, Brasil ICF, Oliveira JTA, Campello CC, Maia FMM, Campello MVM, et al. Combination of Chemical Analyses and Animal Feeding Trials as Reliable Procedures to Assess the Safety of Heat Processed Soybean Seeds. Journal of Agricultural and Food Chemistry[Internet].AmericanChemicalSociety(ACS);2009 Jun10;57(11):4668–73.Available from:http://dx.doi.org/10.1021/jf803903h
11. Batal A, Parsons C. Utilization of different soy products as affected by age in chicks. Poultry Science [Internet]. Elsevier BV; 2003 Mar;82(3):454–62. Available from: http://dx.doi.org/10.1093/ps/82.3.454
12. ARABA M, DALE NM. Evaluation of Protein Solubility as an Indicator of Over processing Soybean Meal. Poultry Science [Internet]. Elsevier BV; 1990 Jan;69(1):76–83. Available from: http://dx.doi.org/10.3382/ps.0690076
13. Carole N. (2007). "A Healthy Rat Diet".Retrieved fromwww.rattitude.com/articles/information/healthy.rat-diet/
14. Robinson, R.,(1979). "Taxonomy and Genetics". The Laboratory Rat, vol I. Academic Press, New York.37-54.
15. Harkness , J.E., and Wagner, J.E.(1983) *The Biology and medicine of Rabbits and Rodents (second edition),2-36* lea and Febiger, PhiladelphiaPA.
16. Krinke, G.J.(2000). "History, Strain and Models." *The Laboratory Rat.*Academic press, Waltham, Massachusetts, pp3-6.
17. Iseme, A.D., Apostolos, I.T., Lubna, K., Efrosini, P., George P. L.(2010). "malocclusion in aging Wistar Rats*". Journal of American Laboratory Animal Science:* 49(1):22-26
18. Alexander G.(1979) "Cold Thermogenesis: Rev. Physiological environmental physiology III vol. 20. University Park Press, Baltimore MD.43-155.
19. Bivin W.S., Crowford M.P., and Brewer, N.R(1979). The Laboratory Rat. Vol 1, Biology and Diseases. Academic Press, New York, NY.73-103.
20. James *,* G.F., Bennet, J.C., Franklin, M.L.(1984). *Laboratory Animal Medicine.* Academic press inco publishers, San Diego, Carlifornia.pp92-97.
21. McGee , M.A. and Maronplot, R.R.(1979) Harderian gland dacryoadnitis in rats resulting from orbital bleeding. *Journal of Animal Science* 29:639
22. Hedin, S.G.(1991). "The haematocrit: a new apparatus for the investigation of Blood". *Scandinavian physiological Society* 2:134-140.
23. Timm, K.I., (1979). "Orbital Venous Anatomy of the Rat". Journal of Animal Science.22:636.
24. Norman, H., Hadlai, H., Dale, H. (1971). SPSS: Statistical Package for Social Sciences. National Opinion Research Centre, Chicago.
25. Hammond BG, Vicini JL, Hartnell GF, Naylor MW, Knight CD, Robinson EH, et al. The Feeding Value of Soybeans Fed to Rats, Chickens, Catfish and Dairy Cattle Is not Altered by Genetic Incorporation of Glyphosate Tolerance. The Journal of Nutrition [Internet]. Oxford University Press (OUP); 1996 Mar 1;126(3):717–27. Available from:http://dx.doi.org/10.1093/jn/126.3.717
26. Jafarnejad S, Farkhoy M, Sadegh M, Bahonar AR. Effect of Crumble-Pellet and Mash Diets with Different Levels of Dietary Protein and Energy on the Performance of Broilers at the End of the Third Week. Veterinary Medicine International [Internet]. Hindawi Limited; 2010;2010:1–5. Available from:http://dx.doi.org/10.4061/2010/328123.

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