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Physical Quality of Complete Pellets Feed Containing Peanut Waste (*Arachis hypogaea*) and Its Effects on Rabbit Growth Performance

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ABSTRACT

This study aimed to evaluate the physical quality of complete pellets with the addition of peanut waste and the effect of its administration on the performance of rabbits. A total of 20 local male rabbits aged 12 weeks with an average body weight of 1335.60 ± 280.53 g are divided into five groups based on body weight, and then used in this study which is performed in randomized block design (RBD). The rabbits are fed on the commercial pellets as a control diet (P0) and feed pellets containing peanut waste at the level of 5% (P1), peanut waste 10% (P2), and peanut waste 15% (P3). The results show that the physical quality of the pellets was not significantly different ($p > 0.05$) in all treatments. Feeding complete pellets with the addition of peanut waste rabbits performances show no significant difference in performance ($p > 0.05$) in all treatments. In conclusion, complete pellets with the addition of peanut was can resemble the physical quality of commercial pellets (control), maintain performances.

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Introduction

The increasing number of rabbit populations provides an excellent opportunity to develop as this animal meat-producing in the livestock business sector. Rabbit meat contains low protein and fat (Brahmantiyo *et al.*, 2017). The advantages of rabbit livestock are relatively rapid growth, efficient use of feed, short harvest period, and not requiring large land areas (Escorza *et al.*, 2019). The continuous availability of feed has a significant influence in rearing the rabbits of which their feeds can come from forage and even agro-industrial waste. This waste has great potential to be processed into animal feed because it is highly obtainable and does not compete with humans, one of which is peanut waste. Peanut-based food production plants leave peanut waste as straw, peanut shells, and unsorted peanuts. This waste results in an accumulation and has an impact on environmental pollution.

Based on analyses at the Center for Biological Resources and Biotechnology of IPB (2023), peanut waste has good nutrient contents in the form of dry matter 84.89%, ash 28.81%, protein 20.92%, fat 13.78%, crude fiber 20.02%, nitrogen free extract (NFE) 16.47%, and total digestible nutrient (TDN) 50.24%. The rabbit digestive tract, with a simple stomach and cecum-containing

microbes, is helpful for fermentation (Yuliyanto *et al.*, 2019). The nutrient requirements of a rabbit in the growth phase or young age of 5 weeks to 12 weeks are moisture content of 12%, ash of 14%, protein 16%, fat 2%, crude fiber of 14%, calcium (Ca) 0.50%, phosphorus (P) 0.40% and digestibility energy 2,500 kcal (Indonesia National Standar 2018). According to (Aritonang *et al.*, 2004), a rabbit needs 15-20% of crude fiber. Peanut waste can be used as a source of protein and fiber-feed ingredients to replace grass. Therefore, a technological approach is needed to process the waste so that it can be used as feed and is available for a long time. Add feed Pellets are a modified form of mash with a pressing process using a pelleting machine to become hard and compact (Majiid *et al.*, 2020).

Feed pellets are made by mixing several feed ingredients forming small molding bars sizing 3-4 cm are formed (Zaenuri *et al.*, 2019). Pellet feed processing pelleted feed provides convenience; feed can be stored for a long period, and easy to feed, in cost and time efficient, and easy to handle. This study hypothesizes that adding peanut waste has no effect on the physical quality of complete pellets and the performance of rabbits in the growth phase. Based on these thoughts, this study aims to evaluate the physical quality of complete pellets with the addition of

peanut waste and the effect of its administration in the diet on rabbit performance.

Materials and Methods

Experimental diets

Pelleted feed for rabbits in the growth phase aged 5-12 weeks was formulated National based on Indonesia National Standard 8509:2018. The formulation carried out using the trial and error method. The control treatment (P1) in this experiment used a commercial pellet that only presented the chemical composition on its market. The ration formulation and feed nutrient content are presented below.

Making feed pellets

The materials used in making pellets were peanut waste (peanut shells, peanut skin, and unsorted peanuts), bran, corn, soybean meal, coconut meal, palm kernel meal, pollard, cassava, molasses, salt, CaCO₃, and premix. While the equipment consisted of pelleting machines, mixers, and digital scales. Peanut waste was processed through drying and grinding. The method of making feed pellets was done as follows: all feed ingredients were weighed according to the formulation (Table 1) using digital scales and then mixed using a WLH 200 mixer machine with a capacity of 100 kg, and next proceeded with molding process using a pelleting machine at a temperature of 75-87°C for 15-20 seconds until resulting in feed pellets. The process can increase the starch content as an adhesive. Then final process was to dry the feed pellets and then

packed them using plastic bags, coat with sacks, and vacuum.

Animal and experimental design

The animals used were 20 local Indonesian male rabbits aged three months, as many as 20 rabbits with an average body weight of 1335.60 ± 280.53 g. They were grouped based on body weight sizes: very small, medium, large, and very large. The study was designed into a randomized block design (RBD) consisting of four treatment and five replicates. The treatments were commercial pelleted feed without the addition of 0% peanut waste (P1) and pelleted feed with the provision of peanut waste at the level of 5% (P2), pelleted feed with the provision of peanut waste at the level of 10% (P3), and pelleted feed with the provision of peanut waste at the level 15% (P4). Rabbits were kept in individual cages to avoid eating pellets from others. Each treatment had different rabbit body weight categories. Each cage was completed by different manure collection, feed, and water containers. Cages were washed with clean water to avoid disease transmission and then disinfected by a disinfectant agent to sterilize the cage. The cages were left empty for two weeks before being occupied by the rabbits. Feed ingredients and nutrient content in this study can be seen in Table 1. Subsequently, rabbits was allocated randomly to individual cages, and then feed experimental diets for five weeks with a feed adaptation period during the first week. Every day, rabbits were given pelleted feeds 140 g/head/day: 70 g in morning and 70 g in at night. The pellets given in this study meet the Indonesia National

Table 1. Ration formulation and nutrient content of peanut waste pellets (% DM)

Feed ingredients	Rabbit feed formulation (%)			
	P1	P2	P3	P4
Peanut waste	0.00	5.00	10.00	15.00
Bran	30.00	25.00	20.00	15.00
Corn	10.00	6.00	10.00	10.00
Pollard	8.50	5.00	10.00	10.00
Soybean meal	10.00	10.00	15.00	15.00
Coconut meal	20.00	20.00	10.00	8.50
Oil palm meal	15.00	20.50	15.00	10.00
Cassava flour	4.00	6.00	7.50	14.00
Molasses	1.40	1.40	1.40	1.40
Salt	0.20	0.20	0.20	0.20
CaCO ₃	0.70	0.70	0.70	0.70
Premix	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Nutrient composition (%)	Nutrient content			
	P1	P2	P3	P4
Dry material	89.11	89.69	92.27	90.34
Water content	10.89	10.31	7.73	9.66
Ash	10.45	9.69	9.68	9.84
Protein	15.58	15.26	15.42	15.96
Fat	3.97	5.01	5.83	5.67
Crude fiber	12.10	17.06	16.43	14.36
Calcium (Ca)	0.80	0.42	0.41	0.39
Phosphorus (P)	0.50	0.37	0.37	0.38
Nitrogen-free extract (NFE)	47.01	42.67	44.91	44.51
Total digestible nutrient (TDN)	83.01	86.26	89.87	87.58

Proximate analysis of the Ministry of Agriculture's feed quality testing and certification; AOAC proximate analysis method (2005).

P1: complete pellets without the addition of peanut waste, P2: complete pellets with the addition of 5% peanut waste, P3: complete pellets with the addition of 10% peanut waste, P4: complete pellets with the addition of 15% peanut waste.

Nutrient composition was tested by proximate analysis using the AOAC 2015 method.

Testing was carried out at the Laboratory of the Center for Quality Testing and Feed Certification of the Ministry of Agriculture, Bekasi Regency, West Java.

Standard number 9509:2018 nutrient requirements of growth phase rabbits. The method used in this research had considered animal welfare and veterinary supervision. The remaining feed pellets were then weighed and recorded. The drinking water was supplied *ad libitum*.

Sampling and measurement

The physical qualities of the pellets were measured including moisture content using the PM-650 Grain Moisture Tester and water activity using a hygrometer (*Aw-wert-Messer Lufft* 5803.00) (Leistner and Rodel, 1976). Pile density was measured, pile compaction density and specific gravity were measured using the Khalil method (1999).

Pile density or "pellet hardness" was measured by dividing the weight of the pellet (g) and the volume of space (g/mL^{-1}), and pile compaction density was calculated by dividing the weight of feed (g) and the volume of space after compaction (g/mL^{-1}). Compression at the same time, the specific gravity was obtained by (López *et al.*, 1996) The specific gravity was obtained by dividing the weight of feed (g) and the change in the volume of distilled water (mL). The impact resistance of pellets was measured using a pelleting durability tester. Measurement of rabbit performances aimed to examine the effect of experimental diets on, body weight gain, and feed efficiency. Feed consumption was calculated by subtracting the amount of feed given (g/head/day) minus the feed rest (g/head/day). Body weight was measured once a week and the increase in body weight was calculated using the formula of final body weight (g), then divided by the length of rearing. Feed utilization efficiency was calculated using the formula of feed consumption (g) divided by the body weight gained (g). Chemical testing to determine the nutritional content of feed according to the standard procedure method of the Association of Official Analytical Chemists (AOAC, 2005).

Analysis statistics

The study designs used were a completely randomized design (CDR) to analyze the physical quality of pellets and a randomized block design (RBD) to analyze the performance of rabbits with four treatments and five replications (Steel and Torrie, 1993). The data were processed using Analysis of Variance (ANOVA). If the data showed a significant difference ($P < 0.05$), then the analysis was continued using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Physical quality of pellets

The analysis of variance showed the effect of adding peanut waste on the physical quality of the pellets presented in Table 2. Based on the results of the analysis of variance, there was no significant difference ($p > 0.05$) in moisture content,

water activity (*Aw*), pile density, pile compaction density, specific gravity, and pellet durability index.

Water content

The analysis of variance showed no significant difference ($p > 0.05$) in the moisture content of complete pellets with the addition of peanut waste. Related to the process of pellet that produces heat so that water evaporation occurs, the drying process by utilizing sunlight also plays a role in reducing. The moisture content of the pellets obtained was ranging from 9.32-11.98%, which was still considered in the excellent category and agrees with the standard provisions. Similar research conducted by Harahap *et al.* (2020) reported the results of the variance of moisture content of pellets made from sago pulp with the addition of *Indigofera* showed no significant difference. The maximum limit of moisture content still classified safe for feed storage is 14% (Indonesia National Standard, 2006). Moisture content affected the shelf life of pellets, so high moisture content will cause the feed to mold faster and shortened the shelf life, while low moisture content will extend the shelf life of the feed (Saenab *et al.*, 2010). The feed storage process and ambient temperature affect the decrease in moisture content (Nurhayati and Maryani, 2018).

Water activity

The results of variance analysis showed that there was no significant difference ($p > 0.05$) in the water activity (*WA*) of complete pellets with the addition of peanut waste. This was likely because the drying process of the pellets had a low rate of water activity, that help to extend the shelf life of the pellets. The decreased in water content affected water activity. The water activity obtained was ranging from 0.33-0.45%, which were safe relatively safe in the storage process. The range of water activity values was between 0 - 1, so the more significant the water activity value, the smaller the durability of the feed.

According to Lisa *et al.* (2015), water activity for mold growth ranges from 0.6-0.7%, water activity for yeast growth 0.8-0.9%, and water activity for bacterial growth 0.9%. Water activity and low water content in feed would extend the shelf life and preserve feed compared to feed ingredients with high water content and water activity (Saputra *et al.*, 2013).

Pile density and pile compaction density

Based on the results of variance analysis, there was no significant difference ($p > 0.05$) on the pile density and pile compaction density of complete pellets with the addition of peanut waste. This was influenced by the moisture content of the feed ingredients, where the low pile density was directly proportional to the decrease in low moisture content. The use of peanut waste can maintain the quality of pile density. The pile and compaction densities obtained are 0.45-0.61 (g/mL^{-1}) and 0.48-0.59 (g/mL^{-1}).

Table 2. Effect of treatment on the physical quality of pellets

Parameter	P1	P2	P3	P4
Moisture content (%)	9.32±0.60	11.80±0.55	11.44±0.55	11.98±0.92
Water activity (WA)	0.45±0.03	0.45±0.01	0.41±0.01	0.33±0.03
Pile density (g/mL ⁻¹)	0.61±0.02	0.49±0.30	0.51±0.02	0.45±0.03
Pile compaction density (g/mL ⁻¹)	0.59±0.01	0.50±0.03	0.49 0.05	0.48±0.03
Specific gravity (g/cm ³)	1.37±0.15	1.18±0.06	1.18 ±0.07	1.17±0.04
Pellet durability index (%)	97.44±1.35	96.96±1.34	96.62±0.16	97.86±1.42

The variance results showed no significant difference ($p>0.05$) in the physical quality of complete pellets with the addition of peanut waste. P1: complete pellets without the addition of peanut waste, P2: complete pellets with the addition of 5% peanut waste, P3: complete pellets with the addition of 10% peanut waste, P4: complete pellets with the addition of 15% peanut waste.

According (Harahap *et al.*, 2020), pile density and pile compaction density are affected by moisture content, an increase in moisture content results in a decrease in pile density. The pile density value was positively correlated, so the higher the pile density value, the higher the pile compaction density value. A high pile compaction density value will require a smaller volume of space to facilitate storage (Raharja *et al.*, 2020).

Specific gravity

The results of variance showed no significant difference in specific gravity ($p>0.05$) of complete pellets with the addition of groundnut waste. This study's average specific gravity values ranged from 1.17-1.37 (g/cm³). The particle size of the ratio influences specific gravity as the constituent material of the pellets where the smaller the particle size, the better the quality of the pellets produced (Harahap *et al.*, 2022). According to Retnani *et al.* (2011), the higher the specific gravity, the more the storage space capacity will increase and facilitate transportation.

Pellet durability index

The results of the variance analysis were similar ($p>0.05$) on the pellet durability index with the addition of peanut waste. This was thought the low water content in the pellets resulted in compact pellets which were not being easily destroyed. This study's average impact resistance value ranged from 96.62-97.86%. The value of good pellet impact resistance is at least 80% (Retnani *et al.*, 2010). Similar research conducted by Rahmana *et al.* (2020), reported that the impact resistance of pellets with the addition of palm fronds showed no significant difference.

According to Jaelani *et al.* (2016), moisture content causes cavities between pellet particles so the cavity size becomes more comprehensive, and the hardness of pellets was reduced and easily destroyed. These results meet the recommended impact resistance standards Retnani *et al.* (2011) of around 80% so the pellets are suitable for storage.

Rabbit performance

The effect of feeding complete pellets containing peanut waste on rabbit performance is presented Table 3. Based on the results of variance analysis, there were no significant differences ($p>0.05$) in consumption, body weight gain, and feed efficiency.

Feed consumption

The variance results showed no significant difference ($p>0.05$) in rabbits feed consumption. This was influenced by the content of nutrients in feed such as dry weight, protein, and crude fiber. Similar research was conducted by (Yuliyanto *et al.*, 2019), who reported the results of variance analysis of rabbits feed consumption given a source of peanut waste ($p>0.05$). Rabbit feed consumption obtained ranged from 114.51-126.58 g/head/day. According to Wardhana *et al.* (2014), feed energy in each treatment is similar, resulting in almost the same feed dry weight consumption. The dry weight consumption affected the consumption of crude protein, fiber, and fat. Another factor affecting feed consumption is the form of feed and palatability of same livestock.

This was likely because rabbits were accustomed to consumption pellet-shaped feed and rodent. According to Polli *et al.* (2015), giving the form of feed pellets can increase feed consumption because it is hard and compact. Based on this, the consumption of pellet feed was not significantly different in each treatment or tends to be the same in all treatments.

Body weight gain

The result of variance obtained were not significantly different ($p>0.05$) on rabbit body weight gained; This was influenced by the consumption and intake of nutrients that enter the rabbit's body in each treatment. Increased consumption will result in high rabbit body weight. The results of body weight gain from this study are similar to those obtained by Yuliyanto *et al.* (2019), reported variance analysis of the increase in body weight of rabbits given complete pellets with the addition of peanut waste showed no significant difference. The body weight gain was 71.85-90.55 g/head/day. Maximum nutrient absorption by the body will help to accelerate the development of body tissue and fat deposits.

According to Saraswati *et al.* (2018), protein and fat are sources of energy to support the increased rabbit body weight. Pellet consumption, nutrients, and the environment influence increased body weight (Maryani *et al.*, 2015). The growing period of rabbit livestock needs protein and energy intake as basic life needs for tissue development and improvement performances (Zaenuri *et al.*, 2019). Based on this research, rabbits given complete pellets with the addition of peanut waste was not significantly different in body weight in all the treatments that the increase in rabbit body weight was relatively the same in each treatment.

Table 3. Effect of feeding groundnut waste pellets on rabbit performance

Parameters	P1	P2	P3	P4
Feed consumption (g/head/day)	114.51±12.49	126.26±6.92	122.13±10.97	126.58±10.28
Body weight gain (g/head/day)	77.38±8.14	71.85±8.05	73.70±14.10	90.55±13.23
Feed efficiency	0.68±0.09	0.57±0.03	0.61±0.18	0.72±0.16

The variance results showed no significant difference ($p>0.05$) on feed consumption, body weight gain, and feed efficiency.

P1: complete pellets without the addition of peanut waste, P2: complete pellets with the addition of 5% peanut waste, P3: complete pellets with the addition of 10% peanut waste, P4: complete pellets with the addition of 15% peanut waste.

Feed efficiency

The variance results showed no significant difference ($p>0.05$) in the feed efficiency of rabbits in this study; this was because rabbits consumed well the pelleted feeds, and then numerous nutrients in the feed were absorbed by the body, then converted into the body mass. The increase in feed consumption and body weight were linear resulting in relatively the same feed efficiency. Similar research conducted by (Yuliyanto *et al.*, 2019), reported rabbit feed given peanut waste as a source of fiber were similar in feed efficiency. Absorbs nutrients in the feed and then converts them into body mass. The average feed efficiency in this study ranged from 0.72-0.57.

This result was still included in the good enough category because the low feed efficiency value indicates increased feed efficiency. According to Maryani *et al.* (2015), stated that the lower the feed efficiency value, the higher the feed utilization. The genetics of rabbits influence the efficiency of good feed and the quality of feed nutrients met the nutrient needs of rabbits (Nugroho *et al.*, 2013).

Conclusions

The addition of peanut waste does not reduce the physical quality of the pellets and is able to resemble the quality of commercial pellets. Feeding rabbits on complete pellets with the addition of peanut waste produced the equal performances including feed consumption, body weight gain and feed efficiency.

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References

- Aritonang, D., M. A. Harahap, and Y.C. Raharjo. 2004. Effect of Adding Biovet to Diets with Various Protein-Energy Contents on The Growth of Rex Rabbit Calves. *Jurnal Media Peternakan* 27: 69-76.
- AOAC. 2005. Official Methods on Analyses 15th ed. Association of Official Analytical Chemist, Arlington.
- Brahmantiyo, B., H. Nuraini, and D. Rahmadiansyah. 2017. Carcass productivity of Hyla Hycole and New Zealand White rabbits. *Jurnal Media Peternakan* 30: 616-626. <http://dx.doi.org/10.14334/Pros.Semnas.TPV-2017-p.616-626>.
- Escorza, M. M., G. A. Lariso, J. G. Esquivel, M. A. Martinez, and S. S. Simental. 2019. Productive performance and meat quality of rabbits that consumed and meat quality of rabbits that consumed cookies peanut waste. *Journal Abanico Veterinario. Sci.* 9: 1-7. <http://dx.doi.org/10.21929/abavet.2019.910>.
- Harahap, A. E., W. N. H. Zain, A. Fauzi, and B. Solfan. 2022. Physical quality of pelleted feed made from sago pulp with the addition of indigofera using different level of tapioca starch. *Jurnal Nutrisi Ternak Tropis dan Ilmu Pakan* 3: 40-48. <https://doi.org/10.24198/jnttip.v3i2.606>.
- Harahap, S., A. E. Harahap, and E. Irawati 2020. Physical properties of pellets through the addition of kapok banana peel flour rations stored for different times. *Jurnal Nutrisi Ternak Tropis* 3: 71-80. <https://doi.org/10.21776/ub.jnt.2020.003.02.4>.
- Indonesia National Standar. 2018. Rowth or Young Phase Rabbit Feed 8509. National Standardization Agency Publisher, Jakarta.
- Indonesia National Standar. 2006. Broiler Starter Ration 01-3930-2006. National Standardization Agency Publisher, Jakarta.
- Jaelani, A., S. Dharmawati, and Wacahyono. 2016. Effect of stack and time storage of pellet feed to physical quality. *Jurnal Ziraa'ah* 41: 261-268. <https://dx.doi.org/10.31602/zmip.v4i2.429>.
- Khalid. 1999. Effect of water content and particle size to change physical behavior of local feed ingredients: stack density, density piled compaction and specific gravity. *Livestock Media* pp. 1-11.
- Lisa, M., L. Musthofa, and S. Bambang. 2015. Effect of Temperature and Drying Time on Flour Quality of White Oyster Mushroom (*Plaeotus ostreatus*). *Jurnal Teknik Pertanian Tropis* 3: 270-279. <https://dx.doi.org/10.21776/jkptb.v3i3.293>.
- López, G., G. Ros, F. Rincon, M. J. Periago, M. C. Martinez, and J. Ortuno. 1996. Relationship between physical and hydration properties of soluble and insoluble fiber of artichoke. *Journal Agricultural Food Chemistry Sci.* 44: 2773-2778. <https://doi.org/10.1021/JF9507699>.
- Leistner, L. and W. Rodel 1976. Inhibition of Microorganisms in Food by Water Activity. In: *Inhibition and Inactivation of Vegetative Microbes*. F. A. Skinner (ed). Academic Press, San Diego, pp. 219-225.

- Majiid, A. R., S. Mukodiningsih, and S. Sumarsih. 2020. Effect of seaweed in rabbit feed pellets on the hardness, durability and organoleptic. *Jurnal Sains Peternakan Indonesia* 15: 360-366. <https://doi.org/10.1088/1755-1315/443/1/012018>.
- Maryani, A., D. Kardaya, and E. Dhinasih. 2015. Production perform of the local rabbit meat feed additional soursop leaf meal (*Annona Muricata*. L) and zeolite. *Jurnal Peternakan Nusantara* 1: 2442-2541. <https://doi.org/10.30997/jpnu.v1i11.149>.
- Nurhayatin, T. and P. Maryati. 2018. The effect of processing method of arrow root tuber (*Maranta arundinacea*) as binder length of storage time on physical quality pellet feed for chicken broiler. *Jurnal Ilmu Peternakan* 2: 33-40. <https://doi.org/10.52434/janhus.v2i1.260>.
- Nugroho, S. S., P. S. B. Subur, and Panjono. 2013. The effect of pellet and mash concentrates utilization on feed palatability and performance of rabbit bucks feed native grass as basal diet. *Jurnal Buletin Peternakan. Sci.* 36: 169-173. <https://doi.org/10.21059/buletinpeternak.v36i3.1625>.
- Polli, P. F., K. Maaruf, Y. Kowel, H. Liwe, and Y. C. Raharjo. 2015. The effect of high and low protein additives (enzymes and organic acids) in bran-based feed on rabbit performance. *Jurnal Zootek* 35: 280-288. <https://doi.org/10.35792/zot.35.2.2015.8484>.
- Retnani, Y., S. Nining, L. Rahmayeni, and Herawati. 2010. The physical characteristic test of broiler ration pelleted that added of onggok as binder with water spraying process. *Jurnal Agripet* 10: 14-18. <https://doi.org/10.20956/jitp.v1i2.668>.
- Retnani, Y., L. Herawati, and S. Khusniati. 2011. Physical characteristics on crumble ration of broiler starter using tapioca, bentonite and onggok binders. *Jurnal Ilmu dan Teknologi Peternakan* 1: 88-97. <https://doi.org/10.20956/jitp.v1i2.668>.
- Raharja, S., T. Nurhayati, and E. Herawati. 2020. The influence of substitution of rice bran by fermented banana corm on physical characters of pellets. *J. Animal Husbandry Sci.* 5: 125-132. <https://10.5243/janhus.v5i1.1120>.
- Rahmana, I., D. A. Mucra, and D. Febrina. 2020. Physical quality of final broiler chicken pellet with addition of livestock faces and different adhesives. *Jurnal Peternakan* 13: 33-40. <https://10.24014/jupet.v13i1.2387>.
- Saraswati, A. W., A. A. A. Mohammad, P. A. Wibawati, R. Damayanti, B. Agustono, and M. T. E. Purnama. 2018. The effect of hala powder (*Pandanus tectorius*) substitution in pellet on dry matter intake and weight gain of broiler rabbit. *Jurnal Medik Veteriner* 1: 57-61. <https://doi.org/10.20473/jmv.vol1.iss3.2018.57-61>.
- Saputra, F. F., J. Achmadi, and E. Pangestu. 2013. Efficiency complete feed basic material bagasse with difference level at local goat. *Animal Agriculture Journal* 2: 137-147. <http://ejournal-s1.undip.ac.id/index.php/aaj>.
- Saenab, A., E. B. Laconi, Y. Retnani, M. Sayuti, and Mas'ud. 2010. Evaluation of the quality of complete rations containing pellets. *Jurnal Ilmu Ternak dan Veteriner* 15: 31-39.
- Steel, R. G. D. and J. H. Torrie 1993. Principles and procedures of statistics: a biometric approach. Gramedia Pustaka Utama, Jakarta.
- Wardhana, R. P., Fernandy, D. S. Sudiyono, and R. Dewanti. 2014. The effect of fresh cornhusk supplementation in the diet on dry matter and organic matter digestibility and carcass yield of male New Zealand White crossbred rabbit. *Buletin Peternakan* 38: 150-156. <https://10.21059/buletinpeternak.v38i3.5250>.
- Yuliyanto, N. F., E. Purbowati and R. A. Winarti. 2019. Productivity of New Zealand White rabbits with different feeding of fiber source. *Journal Bulletin of Applied Animal Research. Sci.* 1: 30-34. <https://doi.org/10.36423/baar.v1i2.270>.
- Zaenuri, R. and B. Suharto. 2019. The quality of fodder fish pellets from agriculture wastes. *Jurnal Sumberdaya Alam dan Lingkungan* 1: 31-36.