P-ISSN: 2304-3075; E-ISSN: 2305-4360
International Journal of Veterinary Science
www.ijvets.com; editor@ijvets.com

Research Article https://doi.org/10.47278/journal.ijvs/2022.144

Growth Performance and Lipids Profile of Meat of Native Chicken Fed with Feed Substituted with Fermented Banana Peel

I Made Nuriyasa[1*], I Ketut Puja[2] and Anthonius Wayan Puger[3]

[1]Animal Anatomy and Physiology Laboratory, Faculty of Animal Science, Udayana University, Jalan PB Soedirman, Denpasar, Bali, Indonesia; [2]Veterinary Genetics and Reproduction Technology Laboratory, Faculty of Veterinary Medicine, Udayana University, Bali, Indonesia; [3]Animal Nutrition Laboratory, Faculty of Animal Science, Udayana University, Jalan PB Soedirman, Denpasar, Bali, Indonesia
***Corresponding author:** madenuriyasa@unud.ac.id

Article History: 22-520 Received: 29-Jan-22 Revised: 21-Feb-22 Accepted: 25-Feb-22

ABSTRACT

This study aims to determine the growth performance, and lipids profile of meat native chicken fed substitution fermented banana peel in feed. Using a completely randomized design, male native chickens (n=200) were randomly distributed into four treatment groups (5 replicates with 10 chickens per replicate). The treatments consisted of T1 (basal diet without substitution). T2, T3, and T4 substitution of fermented banana peel 5, 10, and 15%, respectively. The results showed that the nutrient digestibility of the feed was not affected by the substitution treatment of fermented banana peel in the feed. The performance of native chickens increased significantly ($P<0.05$) in the feed treatment with fermented banana peel substitution by up to 10%. Dietary substitution with supplementation of banana peel in native chickens decreased the total cholesterol, triglycerides, and HDL levels. It may be concluded that the fermented banana peel can be used as an alternative nutrient in native chicken feed, increasing productivity.

Key words: Banana peel, Digestibility, Lipid, Performance, Native chicken.

INTRODUCTION

The Indonesian poultry sector plays an important role in improving the status of food security. Both commercial and small-scale poultry companies are growing rapidly, thereby increasing the demand for poultry feed. The poultry industry is a contributor to the national economy, supplies 65% of the total animal protein needs, and employs 10% of the national labor force.

Indonesia is a country that is rich in the genetic resources of native chickens. There are 31 native chickens breeds in Indonesia. Native chickens are generally kept in many areas of Indonesia and play an important role in providing animal protein for the community (Henuk and Bakti 2018). People usually raise native chickens for religious, feed, ornamental, and trade purposes. Native chicken products are very popular in the Indonesian market, so in Indonesia, the price of native chicken meat is higher than broiler meat. This is because the chicken meat has a certain texture, preferred taste by most of the Indonesian people (Hidayat and Asmarasari 2015).

Chicken meat is one of the most consumed food products of animal origin throughout the world (Abdel-Naeem et al. 2022) and chicken meat is acceptable to many religions (Pas et al., 2020). The increased demand for meat-type chicken has had a direct effect on the price of feed (Diarra 2018). The main constraint of poultry production is the high cost of commercial diet (Abdelnour et al. 2018). The cost of feed has always been a significant problem in the production of native chickens. Production costs continue to increase due to fluctuations in the price of raw materials such as soybeans, corn, and others and their availability is often disrupted because some of the materials are imported.

Lately, consumers are increasingly selective in choosing animal meat as food. The main concern is the reduction of individual energy intake, prevention of foods with high fat and carbohydrate content. Also, texture, tenderness, smell, and taste are the most important features of meat that influence consumer judgment before buying meat products (Mir et al. 2017). The high-fat content in foodstuffs tends to be a major consideration to avoid being consumed. High-fat content is a source of cholesterol and this can have an impact on health. Consumers are interested in meat that can contribute to their satisfaction (Mickdam et al. 2022). Consumers prefer the meat of chicken

Cite This Article as: Nuriyasa IM, Puja IK and Puger AW, 2022. Growth performance and lipids profile of meat of native chicken fed with feed substituted with fermented banana peel. International Journal of Veterinary Science 11(4): 455-460. https://doi.org/10.47278/journal.ijvs/2022.144

exclusively fed with vegetable sources because vegetable waste could be improved lipid oxidation status (Raza et al. 2019). Due to health and cost considerations, several initiatives have been put in place, such as finding cheaper and locally available materials as a feed supplement in chicken diets (Azizi et al. 2021).

Most agricultural industries produce large amounts of residue every year. The waste materials have great potential in biomass with valuable solutions to animal nutrition problems (Mechkirrou et al. 2021). In Indonesia, waste agro-industrial products including bananas are found in abundance. A large quantity of peel is produced from the processing of bananas. Banana peel contains high crude fiber, crude fat and carbohydrate (Hassan et al. 2018; Hassan and Peh 2018), are high in β-Carotene content (Budhalakoti 2019) as an antioxidant that functions to inhibit the formation of cholesterol and also rich in many health-promoting bioactive phytochemicals (Sidhu and Zafar 2018).

The phytochemical content in banana peels is proven to have antimicrobial and antioxidant properties (Padam et al. 2014). It has abundant phenolic content, including flavan-3-ols and flavanols. In dried banana peel powder, there are catechins, epicatechins, gallocatechin and procyanidins (Vu et al. 2018). The beta-carotene in banana peel flour can function as an antioxidant (Sad et al. 2018; Abdel-Naeem et al. 2022) so that it can prevent the oxidation of unsaturated fatty acids and produce meat products with good fatty acid composition. This study was planned to investigate the effects of the fermented banana peel on the performance and lipids profile of native chickens.

MATERIALS AND METHODS

Ethical Approval

This experimental protocol used in this research was approved by the Animal Ethics Committee, Faculty Veterinary Medicine, Udayana University, Indonesia with an approval number. B/26/UN14.2.9/PT.01.04/2021.

Experimental Design and Animal Management

A total of 200 male native chickens and weighed individually. The chicken was vaccinated according to standard veterinary practices. The chicken was randomly distributed into four treatment groups (5 replicates with 10 chicken per replicate) using a completely randomized design. The treatments consisted of T1 (basal diet without substitution). T2 (substitution of fermented banana peel 5%), T3 (substitution of fermented banana peel 10%), and T4 (substitution of fermented banana peel 15%). The diets were formulated to meet the nutrient requirements of native chicks (Table 1).

The compositions of the diets are shown in Table 1. The diets contained ingredients yellow corn, coconut cake, fish meal, tapioca flour, soybean flour, fermented banana peel, rice bran, coconut oil, NaCl, and mineral mix. Diets were formulated to the same energy content (2800 kcal/kg) and the same protein content (17.5%).

Nutrient Digestibility

The fresh feces were collected from chicken in the morning and air-dried in the sun. The feces were baked for 5 days at 100-105˚C. The baked dried feces were used for analysis. Energy content in dry roasted feces was measured using a bomb calorimeter and protein excretion was measured by Kjelldhal analysis

Nutrient digestibility was calculated as follow:

$$\mathrm{KC} = \frac{(\mathrm{A} - \mathrm{B})}{\mathrm{A}}\ x\ 100\%$$

Description:

KC: Nutrient Digestibility (%)

A: Consumption of nutrients (g)

B: Amount of nutrients in feces (g)

Meat Lipid Profiles

The total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides were measured enzymatically in meat using according to the Boehringer method (1996).

Chicken Performance

Bodyweight gain is calculated as the bodyweight difference between the weight of the chickens at the end and the beginning of the weight during each of the weighing periods. Feed consumption is the quantity of feed ingested by chicken during the experiment. Feed consumption was calculated as taking at a total amount of feed given and refusal was subtracted from offered. Feed Conversion Ratio (FCR) was estimated based on the ratio between weight gain and feed consumption.

Statistical Analysis

Data obtained were analyzed using the general linear model (GLM) and was performed with a software program IBM SPSS Statistics 25. The Least Significant Difference (LSD) test was applied to compare the differences means.

RESULTS

Growth Performance

The dry matter digestibility, efficiency of converting GE to DE, and crude protein digestibility were not affected (P>0.05) by substitution of fermented banana peel into diets native chickens (Table 2). The results showed that chickens were given feed treatment without substitution of fermented banana peel (T1) caused dry matter digestibility 73.35%, feed treatment with fermented banana peel substitution 5% (T2), 10% fermented banana peel substitution (T3), and fermented banana peel substitution 15% (T4) were 73.93, 74.38 and 74.04%, respectively (Table 2).

Chicken body weight at the beginning of the study that received T1 (feed treatment without fermented banana peel supplementation), T2, T3, and T4 were 101.57g; 103.56g; 103.43g, and 100.05g respectively. The initial body weight of chicken in T1, T2, T3, and T4 were not different (P>0.05). This indicates that the chicken presented a uniform body weight at the start of the experiment. After 10 weeks, the body weight in T1, T2, T3, and T4 were 745.62g, 845.34, 852.95, and 759.39, respectively (Table 3). The results revealed that the group fed a substitution with fermented banana peel had a higher significance in body weight compared with T1 (without substitution with fermented banana peel) (P<0.05). The effect of treatment with the substitution of a fermented banana peel on weight gain is presented in Table 3. Chicken fed with substitution fermented banana peel 15% in diets had similar weight gain

Table 1: Ingredients and nutrient content of experimental diet

Composition (%)	Treatments			
	T1	T2	T3	T4
Yellow Corn	34.4	40	38	28
Coconut Meal	10.9	13	13	9.9
Fish flour	15.2	14.6	13.2	15
Tapioca flour	12.6	6.7	7	8
Soy Flour	11.6	10.5	12	11.5
Fermented Banana Peel	0	5	10	15
Rice Bran	13.5	6.5	1.8	3.8
Coconut oil	1.1	2.9	4.2	8
NaCl	0.25	0.3	0.3	0.3
Mineral Mix	0.45	0.5	0.5	0.5
Total	100	100	100	100
	Nutrient Content			
Energy Metabolism (Kcal/kg)	2810.33	2803.15	2808.49	2838.16
Crude protein (%)	17.50	17.53	17.54	17.53
Calcium (%)	0.53	0.56	0.58	0.66
Phosphorus (%)	0.41	0.41	0.39	0.43
Fat (%)	7.06	6.73	6.84	7.41
Crude Fiber (%)	4.90	5.25	5.64	6.16

T1 (Feed treatment without fermented banana peel supplementation), T2 (5% fermented banana peel supplementation), T3 (10% fermented banana peel supplementation), and T4 (15% fermented banana peel supplementation).

Table 2: Digestibility of nutrients in native chickens fed with fermented banana peels with different levels

Variable	Treatment				SEM
	T1	T2	T3	T4	
Dry Matter Digestibility (%)	73.35a	73.93a	74.38a	74.04a	1.89
Efficiency of Converting GE to DE (%)	84.38a	84.89a	85.78a	85.34a	1.02
Crude Protein Digestibility (%)	70.2a	70.91a	71.58a	71.03a	0.98

Feed treatment without fermented banana peel supplementation (T1); fermented banana peel supplementation 5% (T2); 10% fermented banana peel supplementation (T3); 15% fermented banana peel supplementation (T4). Values bearing same letters in a row different non-significantly (P>0.05).

Table 3: Performance of native chickens fed with fermented banana peels at different levels

Variable	Treatments				SEM
	T1	T2	T3	T4	
Initial Body Weight (g)	101.57a	103.56a	103.43a	100.05a	1.74
Final Body Weight (g)	745.62b	845.34a	852.95a	759.39b	22.67
Weight Gain (g/day)	11.50b	13.25a	13.38a	11.77b	0.47
Feed Consumption (g/bird/day)	33.93b	38.56a	38.67a	34.84b	1.22
Feed Conversion	2.95a	2.91a	2.89a	2.96a	0.16

Feed treatment without fermented banana peel supplementation (T1); fermented banana peel supplementation 5% (T2); 10% fermented banana peel supplementation (T3); 15% fermented banana peel supplementation (T4). Different letter in the same line showed significant differences (P<0.05).

Table 4: Cholesterol of native chicken meat treated with feed treatment with fermented banana peels substitution with different levels

Variable	Treatments				SEM2)
	T1	T2	T3	T4	
Total Cholesterol (10^2/mg/dL)	145.07a	88.93b	92.85b	78.09b	34.18
Triglycerides (mg/dL)	80.17a	74.11b	73.85b	76.01b	8.84
HDL Cholesterol (mg/dL)	38.18a	33.35b	32.86b	31.16b	4.57
LDL Cholesterol (mg/dL)	90.86a	90.76a	89.42a	88.73a	13.78

Feed treatment without fermented banana peel supplementation (T1); fermented banana peel supplementation 5% (T2); 10% fermented banana peel supplementation (T3); 15% fermented banana peel supplementation (T4). Different letters in the same line showed significant differences (P<0.05).

compared to the chicken fed without substitution with banana peel (P>0.05). Substitution diets with 5% and 19% fermented banana peel significantly (P<0.05) influenced weight gain.

Chicken fed with substitution fermented banana peel 15% in diets had a similar feed consumption rate compared to the chicken fed without substitution with banana peel (T1). Substitution diets with 5% and 19% fermented banana peel significantly (P<0.05) influenced feed consumption. Feed conversion was not affected (P>0.05) by substitution of fermented banana peel into diets native chickens (Table 3).

Meat Lipid Profiles

As presented in Table 4, the substitution of basal diets with fermented banana peel affected total cholesterol, triglycerides, and HDL Cholesterol of native chicken (P<0.05). Fermented banana peel decreased total cholesterol, triglycerides and HDL Cholesterol significantly. The LDL cholesterol was not affected by substitution diets with fermented banana peel (P>0.05).

DISCUSSION

In this study, the dry matter digestibility, efficiency of converting GE to DE, and crude protein were similar with the treatment without substitution with a fermented banana peel. In the present study, the comparative effect of banana peels on the dry matter digestibility, efficiency of converting GE to DE, and crude protein were non-significant. The results of the present study are different from those reported by Abel et al. (2015), who reported that the treated banana peels on the digestibility. This study indicated that the similar digestibility of banana peel due to the native chicken can digest the nutrients in the feed.

The results of the productive performance (Table 3) showed that the final live weight increased significantly ($P<0.05$) as the level substitution of 5 and 10% banana peel, however increasing level of banana peel have effect decreasing the body weight. Also, the increasing weight gain trend until level substitution 10% banana peel. The fermented banana peel could be used maximally 10% in broiler ration (Koni 2013). The substitution of 5 and 10% banana peel provider adequate non-fiber carbohydrates. The higher non-fiber carbohydrates in banana peels have an increasing effect on body weight (Pimentel et al. 2017). Banana is rich in carbohydrates (22.84g/100g), provides energy of about 370kJ/100g, and is considered to be one of the best sources of potassium (358mg/100g) (Ranjha et al. 2022).

The decreasing of final body and weight gain in native chicken treated with 15% banana peel could be due to the effect of the increasing levels of the banana peel in the diet. The substitution of up to 10% fermented banana peels causes an increase in the crude fiber content of the feed which can also reduce the palatability of the feed which in turn affects the decreased body weight gain. The lowering value could be due to the inability of the birds to digest the nutrients more than 10% substitution of banana peel. The result of this study is in line with the report, that stated banana peel meal can be added up to 10% to broiler chicken diet without any adverse effect on the performance of the birds (Duwa et al. 2014; Abel et al. 2015). In contrast, reported in rabbits, the effect of banana peels on the bodyweight of male growing rabbits was not significantly changed (Rehman and Shah 2020). Also different in cattle, feeding 60% banana peel in diets represents a viable alternative as it causes no change in cows with average production (Pimentel et al. 2017).

Fermented banana peel substitution up to 15% level in the feed causing a decrease in the use of other ingredients that could decrease the palatability of the feed. The substitution of up to 15% fermented banana peels causes an increase in the crude fiber content of the feed which can also reduce the palatability of the feed. This research is also supported by the research results of Nuriyasa et al. (2020). Feed consumption was closely related to feeding palatability. The higher the palatability of the feed, the higher the feed consumption. Palatability is a performance property of feed ingredients as a result of their physical and chemical properties. Differences in feed consumption are influenced by feed quality, feed palatability, and processing (Wahju 2015). The feed consumption will affect the growth rate and final weight because the formation of weight, shape, and body composition is essentially an accumulation of nutrients consumed with crude fiber feed which can also reduce feed delicacy.

In the current study, the native chicken was fed with diets where substitution of banana peel showed a positive effect on the total cholesterol, triglyceride, and HDL cholesterol. Substitution with banana peel up to 15% revealed a decrease in the total cholesterol, triglyceride, and HDL cholesterol level in the chicken while LDL levels were similar compared with feeding diets without the banana peel. The crude fiber contained in the banana peel can bind fat thereby increasing the excretion of fat through feces. Consequently, blood cholesterol is lowered. In the present study, lowering of total cholesterol, and triglyceride, and no significant effect in LDL levels indicate the anti-atherosclerotic effect of supplemental banana peel. Antioxidant compounds contain in banana act to reduce the risk of diseases like cardiovascular diseases (Siji and Nandini 2017). Banana peels are known to contain ß-sitosterol, malic acid, succinic acid, palmitic acid, 12-hydroxy stearic acid, glycoside, which act as an anti-cholesterol (Mokbel and Hashinaga 2005) and has a high antioxidant capacity. (Chuang et al. 2019). The banana peel has considerable antioxidant activity and can be employed in animal feed for variant health enhancement uses (Bashmil et al. 2021).

Similar results were reported by Chuang et al. (2019) in terms of cholesterol and triglycerides levels were decreased in native chickens fed dietary fermented banana peel. This is consistent with result of the study in mice that banana peel proved to decrease total cholesterol (Berawi and Bimandama 2018). This These findings are contrary to those reported by Haryanto et al. (2017) who reported that supplementation of banana peel was not significantly changed in the total cholesterol and increased triglyceride levels in broiler chicken. The differences in results might be due to the difference in chicken breeds. It is thus clear that bananas as much as the flesh compartments have a host of nutritionally and pharmacologically significant values to chicken diets, health, and dietary quality (Oyeyinka and Afolayan 2020).

Conclusion

It was concluded that the substitution of fermented banana peel into native chicken feed had may improve the growth performance. In addition, supplementation of banana peel in native chickens decreased the total cholesterol, triglycerides, and HDL level.

Acknowledgments

We gratefully thank and appreciate this research funded provided by Udayana University, also thank the Dean of the Faculty of Animal Science, for providing facilities for research.

Authors Contribution

IMN and AWP designed, executed the research, and wrote the manuscript. IKP all authors contributed equally to the writing of the final manuscript.

Conflict of Interest

The author declares no potential conflict of interest in this research.

REFERENCES

Abdel-Naeem HHS, Elshebrawy HA, Imre K, Morar A, Herman V, Pascalau R and Sallam KI, 2022. Antioxidant and antibacterial effect of fruit peel powders in chicken patties. Foods 11: 301. https://doi.org/10.3390/foods11030301

Abel FAS, Adeyemi OA, Oluwole OB, Oladunmoye OO, Ayo-Ajasa OY and Anuoluwatelemi JO, 2015. Effects of treated banana peel meal on the feed efficiency, digestibility and cost effectiveness of broiler chickens diet. Journal of Veterinary Science & Animal Husbandry 3: 101. https://doi.org/10.15744/2348-9790.1.603.

Abdelnour SA, Abd El-Hack ME and Ragni M, 2018. The efficacy of high-protein tropical forages as alternative protein sources for chickens: A review. Agriculture 8: 86. https://doi.org/10.3390/agriculture8060086

Azizi MN, Loh TC, Foo HL and Teik Chung EL, 2021. Is palm kernel cake a suitable alternative feed ingredient for poultry? Animals, 11, 338. https://doi.org/10.3390/ ani11020338

Bashmil YM, Ali A, Amrit BK, Dunshea FR and Suleria HAR, 2021. Screening and characterization of phenolic compounds from Australian grown bananas and their antioxidant capacity. Antioxidants 10: 1521. https://doi.org/ 10.3390/antiox10101521.

Berawi KN and Bimandama MA, 2018. The effect of giving extract etanol of Kepok banana peel (*Musa Acuminata*) toward total cholesterol level on male mice (Mus Musculus L.) strain Deutschland-Denken-Yoken (Ddy) obese. Biomedical & Pharmacology Journal 11: 769-774. https://dx.doi.org/10.13005/bpj/1431

Boehringer M, 1996. Lipoprotein. In: Principles of Laboratory Medicine. Boehringer Mannheim Laboratory System.

Budhalakoti N, 2019. Evaluation of β-Carotene content and antioxidant activity of banana peels and banana peel extracted insoluble dietary fibres. International Journal of Agriculture, Environment and Biotechnology 11: 781-789. https://doi.org/10.30954/0974-1712.10.2018.10

Chuang Chi Chueh CC, Lin LJ, Lin WC, Huang SH, Jan MS, Chang SC, Chung WS and Lee TT, 2019. Antioxidant capacity of banana peel and its modulation of Nrf2-ARE associated gene expression in broiler chickens, Italian Journal of Animal Science 18: 1394-1403. https://doi.org/ 10.1080/1828051X.2019.1667884

Diarra SS, 2018. Peel meals as feed ingredients in poultry diets: Chemical composition, dietary recommendations and prospects. Journal of Animal Physiology and Animal Nutrition 102: 1284–1295.https://doi.org/10.1111/jpn.12954

Duwa H, Saleh B, Lamido M and Saidu A, 2014. Growth, haematological and serum biochemical indices of broiler chickens fed banana peel meal as replacement for maize in the semi-arid zone of Nigeria. Online Journal of Animal and Feed Research 4: 121-126.

Haryanto A, Purwaningr M, Andityas M and Wijayanti N, 2017. Effect of chicken feather meal on the feed conversion ratio and blood lipid profile of broiler chickens. Asian Journal of Poultry Science 11: 64-69.

Hassan HF, Hassan UF, Usher OA, Ibrahim HB and Tabe NN, 2018. Exploring the potentials of banana (*Musa Sapietum*) peels in feed formulation. International Journal of Advanced Research in Chemical Science 5: 10-14. http://dx.doi.org/ 10.20431/2349-0403.0505003

Hassan P and Peh KK, 2018. Chemical composition of banana peels (Musa sapientum) fruits cultivated in Malaysia using proximate analysis. Research Journal of Chemistry and Environment 22: 108-113.

Henuk YL and Bakti D, 2018. Benefits of Promoting Native Chickens for Sustainable Rural Poultry Development in Indonesia. ANR Conference Series 01 (2018): 69–77.

Hidayat C and Asmarasari SA, 2015. Native chicken production in Indonesia: A review. Jurnal Peternakan Indonesia 17: 1-11. https://doi.org/10.25077/jpi.17.1.1-11.2015

Koni TNI, 2013. Effect of fermented banana peel on broiler carcass. Jurnal Ilmu Ternak Dan Veteriner 18: 153–157. https://doi.org/10.14334/jit v.v18i2.315

Mechkirrou L, Arabi M, Ouhssine M and El Amine Afilal M, 2021. Food waste reuse as a feed for organic chicken: A case study. E3S Web of Conferences 234: 00090. https://doi.org/ 10.1051/e3sconf/202123400090

Mickdam E, Alwaleed S, Madany M and Sayed A, 2022. The effect of Moringa Oleifera leaves on chicken meat composition and meat quality. International Journal of Veterinary Science 11: 201-206. https://doi.org/10.47278/ journal.ijvs/2021.094

Mir NA, Rafiq A, Kumar F, Singh V and Shukla V, 2017. Determinants of broiler chicken meat quality and factors affecting them: a review. Journal of Food Science and Technology 54: 2997–3009. https://dx.doi.org/10.1007%2 Fs13197-017-2789-z

Mokbel MS and Hashinaga F, 2005. Antibacterial and antioxidant activities of banana (Musa AAA cv. Cavendish) fruit peels. American Journal of Biochemistry and Biotechnology 1: 125. https://doi.org/10.3844/ajbbsp.2005.125.131

Nuriyasa IM, Sukada IK, Puspani E and Ariana NT, 2020. Microbial composition of hind gut, digestability and growth rate of local rabbit with feed fermented banana peels (Acuminata Balbisiana) supplementation. Plant Archives 20: 6334-6338.

Oyeyinka BO and Afolayan AJ, 2020. Potentials of musa species fruits against oxidative stress-induced and diet-linked chronic diseases: In vitro and in vivo implications of micronutritional factors and dietary secondary metabolite compounds. Molecules 25: 5036. http://dx.doi.org/10.3390/ molecules25215036

Padam BS, Tin HS, Chye FY and Abdullah MI, 2014. Banana by-products: an under-utilized renewable food biomass with great potential. Journal of Food Science and Technology 51: 3527-3545. https://doi.org/10.1007/s13197-012-0861-2

Pas MPW, Borg R, Buddiger NJH, Wood BJ, Rebel JMJ, van Krimpen MM, Calus MPL, Park JU and Schokker D, 2020. Regulating appetite in broilers for improving body and muscle development – A review. Animal Physiology and Animal Nutrition 104: 1819–1834. https://doi.org/10.1111/ jpn.13407

Pimentel PRS, Rocha Júnior VR, Parrela de Melo MT, Ruas JRM, Brant LMS, Costa NM, Leite GDO, Leite MDO and de Albuquerque Maranhão CM, 2017. Banana peel in the diet for F1 Holstein x Zebu cows. Ciências Agrárias, Londrina, 38: 969-980. http://dx.doi.org/10.5433/1679-0359.2017 v38n2p969

Ranjha MMAN, Irfan S, Nadeem M and Mahmood S, 2022. A Comprehensive review on nutritional value, medicinal uses, and processing of banana. Food Reviews International 38: 199-225. http://dx.doi.org/10.1080/87559129.2020.1725890

Raza A, Hussain J, Hussnain F, Zahra F, Mehmood S, Mahmud A, Amjad ZB, Khan MT, Asif M, Ali U, Badar IH and Nadeem M, 2019. Vegetable waste inclusion in broiler diets and its effect on growth performance, blood metabolites, immunity, meat mineral content and lipid oxidation status. Brazilian Journal of Poultry Science 21: 001-008. http://dx.doi.org/10.1590/1806-9061-2018-0723

Rehman A and Shah Z, 2020. Effects of banana peels on growth performance, dry matter digestibility, and feed efficiency of growing male rabbits. European International Journal of Science and Technology 9: 19-28.

Sad SA, Hoquea MM and Zzaman W, 2018. Physicochemical and antioxidant properties of banana varieties and sensorial evaluation of jelly prepared from those varieties available in

Sylhet Region. International Journal of Food Studies 7: 89-97. http://dx.doi.org/10.7455/ijfs/7.2.2018.a8

Sidhu JS and Zafar TA, 2018. Bioactive compounds in banana fruits and their health benefits. Food Quality and Safety 2: 183–188. http://dx.doi.org/10.1093/fqsafe/fyy019

Siji S and Nandini PV, 2017. Antioxidants and antioxidant activity common eight banana varieties in Kerala. International Journal of Advanced Engineering Research and Science 4: 118-123. https://dx.doi.org/10.22161/ijaers.4.7.18

Vu HT, Scarlett CJ and Vuong QV, 2018. Phenolic compounds within banana peel and their potential uses: a review. Journal of Functional Foods 40: 238-248 https://doi.org/10.1016/j.jff.2017.11.006

Wahju J, 2015. Poultry Nutrition Science. Sixth Printing, Gajah Mada University Press, Yogyakarta.