The effect of nutmeg flesh (Myristica fragrans Houtt) extract on growth performance, internal organ and carcass of broiler chickens raised at high stocking density

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The effect of nutmeg flesh (*Myristica fragrans* Houtt) extract on growth performance, internal organ and carcass of broiler chickens raised at high stocking density

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Abstract

This study aimed to evaluate the impact of nutmeg flesh extract on growth performance, internal organ, and carcass characteristics of broiler chickens raised at high stocking density. On day 15, broiler chickens (body weight of 420 ± 2.75 g) were randomly divided into five treatment groups and each treatment was repeated five times, i.e. CTL^- (negative control with normal density of 10 animals/m^2), CTL^+ (positive control with high density of 16 chickens/m^2), NFE0.5, NFE1.0, and NFE1.5 with a high density of 16 chickens/m^2. The nutmeg flesh extract was included to the feed since day 15 as much as 0.5, 1.0, and 1.5 ml/kg for NFE0.5, NFE1.0, and NFE1.5, respectively. Weight gain, feed consumption, and feed conversion ratio (FCR) were recorded weekly. On day 35, one chicken from each replication was taken randomly, slaughtered, and plucked. After evisceration, the internal organs were removed and weighed. The carcass percentage and commercial proportions of broiler chicken were also determined. The results showed that body weight gain, consumption, and feed conversion were higher (p <0.05) in the CTL^-, NFE0.5, NFE1.0 and NFE1.5 groups than the positive control (CTL^+). There was no difference (p> 0.05) in internal organ weight and carcass yield of broiler chicken. The conclusion in this study was that dietary inclusion of nutmeg flesh extract improved the performance of broiler chickens raised at high stocking density.

Keywords: *broilers, carcass, internal organs, nutmeg flesh, weight gain*

Introduction

The need for animal protein continues to increase each year in line with the increase in population. Broiler chicken meat contains high essential nutrients, low levels of saturated fat, and has a relatively cheap price (Kralik et al 2018; Tarakdjian et al 2020), so that it can be an alternative to meet the needs of the community's animal protein needs. To meet the increasing demand for broiler meat and at the same time maximize profits, farmers are required to implement efficient maintenance management, among others through increasing meat production per square meter by applying high stocking density (Feddes et al 2002; Abudabos et al 2013). Apart from production efficiency, increasing the high stocking density has an impact on uncomfortable conditions, thereby increasing the potential for stress, reducing feed consumption, and reducing production and health performance in broilers (Estevez 2007; Mtileni et al 2007).

Changes that occur due to stress are reported to increase the production of free radicals or reactive oxygen species (ROS) and trigger oxidative stress (Kridtayopas et al 2019; Sugiharto et al 2019) and reduce the productivity of broiler chickens. To reduce the negative impact of oxidative stress, ration supplementation using synthetic antioxidants has commonly been used in the maintenance of broiler chickens (Salami et al 2015). However, the use of synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) in the long term and excessive doses can be toxic and carcinogenic to consumers (Tagvaei and Jafari, 2015; Zhou et al 2019). Based on this fact, a natural source of antioxidants is needed so that the use of synthetic antioxidants in broiler chickens can be reduced

Figure 1. Nutmeg tree (*Myristica fragrans* Houtt)

The use of herbal extracts as natural additives in poultry feed has increased in recent years. This is due to the content of bioactive substances in these natural additives which can improve production performance, reduce pathogenic bacteria, and reduce antibiotic residues in meat and egg products (Dhama et al 2015; Reddy et al 2015; Reddy et al 2018). The application of herbal extracts in poultry feed has been reported to increase body weight, facilitate nutrient metabolism, and improve meat quality by lowering cholesterol levels and inhibiting peroxidation (Oloruntola et al 2019). Nutmeg (*Myristica fragrans* Houtt) is a native Indonesian plant that is widely used as kitchen spice. Nutmeg is an aromatic tropical plant (with a distinctive aroma) (Periasamy et al 2016) and has antioxidant, antimicrobial, anti-pain, antiobesity and hepatoprotective activity in biological systems (Morita et al 2003; Olaleye et al 2006; Agbogidi and Azagbaekwe 2013; Periasamy et al 2016; Vangoori et al 2019). Nutmeg consists of flesh, seed and mace. Seed and mace is the main product of nutmeg which is used as kitchen spice, while the flesh is a waste that has no economic value (Assa et al 2014). Currently, studies related to the use of nutmeg flesh extract to improve the productivity of broiler chickens are still very limited, in contrast to the use of nutmeg seed. This study aimed to evaluate the impact of giving nutmeg flesh extract on growth performance, internal organ development and carcass characteristics of broiler chickens raised at high stocking density.

Materials and method

Making nutmeg flesh extract

After being separated from the whole nutmeg, the nutmeg flesh was obtained from a nutmeg plantation in Ternate City, North Maluku Province, Indonesia. Before use, the nutmeg flesh was washed and thinly sliced, and then air-dried and ground into flour before use. One kg of nutmeg flesh was extracted by maceration technique by immersing it in 4 L of 96% ethanol solution for 4 × 24 hours. During the soaking process, stirring was performed twice, in the morning and in the evening. The immersion results in the form of a filtrate were then filtered and evaporated using a rotary evaporator to produce a solution of nutmeg flesh extract (Vangoori et al 2019).

Table 1. Constituents and nutritional compositions of broiler rations

Items (%, except that otherwise mentioned)	Starter (1 -21)	Finisher (22-35)
Yellow corn	56.10	63.55
Soybean meal	36.64	29.83
Palm oil	2.40	2.40
DL-methionine	0. 30	0.30
Bentonite	1.10	0.46
Limestone	1.42	1.42
MCP	1.45	1.45
Premix[1]	0.20	0.20
Chlorine chlorite	0.08	0.08
NaCl	0.31	0.31
Calculated nutritional compositions		
ME[2] (kcal/kg)	2,924	3,040
Crude protein	21.75	19.25
Crude fiber	3.31	3.21
Ether extract	4.43	4.82
Ca	1.20	1.20
P	0.50	0.50
Analyzed nutritional compositions		
ME[2] (kcal/kg)	3,228	3,242
Dry matter	86.73	87.00
Crude protein	19.98	18.05
Ether extract	5.00	5.50
Crude fiber	3.10	2.28
Ash	9.59	10.94

[1]Premix contained (per kg of diet) of vit A 7,750 IU, vit D3 1,550 IU, vit E 1.88 mg, vit B1 1.25 mg, vit B2 3.13 mg, vit B6 1.88 mg, vit B12 0.01 mg, vit C 25 mg, folic acid 1.50 mg, Ca-d-pantothenate 7.5 mg, niacin 1.88 mg, biotin 0.13 mg, BHT 25 mg, Co 0.20 mg, Cu 4.35 mg, Fe 54 mg, I 0.45 mg, Mn 130 mg, Zn 86.5 mg, Se 0.25 mg, L-lysine 80 mg, Choline chloride 500 mg, DL-methionine 900 mg, CaCO3 641.5 mg, Dicalcium phosphate 1500 mg [2]ME (metabolizable energy) was predicted based on formulation (Bolton, 1967) as follow: 40.81 {0.87 [CP + 2.25 crude fat + nitrogen -free extract] + 2.5}

In vivo experiments

A total of 370 Lohmann broiler chickens (unsexed) were farmed together from the age of 0 to 14 days. On day 15, these broiler chickens (body weight 420 ± 2.75 g) were randomly divided into five treatment groups and each treatment was repeated five times, i.e. CTL^- (negative control with normal density 10 chickens/m^2), CTL^+ (positive control with high density 16 individuals/m^2), NFE0.5, NFE1.0, and NFE1.5 with a high density of 16 individuals/m^2. The feed was given in the form of mashed and formulated (Table 1) as starter feed (days 1-21) and finisher feed (days 22-35). The nutmeg flesh extract was added to the feed since the 15th day as much as 0.5, 1.0, and 1.5 ml/kg for NFE0.5, NFE1.0 and NFE1.5, respectively, while the CTL^- and CTL^+ treatments' feed did not have nutmeg flesh extract addition. The formulated feed did not contain enzymes, antibacterial, antifungal, and antiprotozoal properties. Feed and drinking water were given *ad libitum* until day 35. All chickens were vaccinated with commercial Newcastle (ND) vaccine on day 4 through eye drops, on day 18 through drinking water, and on day 12 with the Gomboro vaccine through drinking water. During the raising period, the chickens were kept in a ventilated broiler house with rice husks as litter. Weight gain, feed consumption, and feed conversion ratio (FCR) were recorded weekly. On day 35, one chicken from each replication was taken randomly, slaughtered, and plucked. After evisceration, the internal organs were removed and weighed. The carcass percentage and commercial proportion of broiler chicken carcass were also determined.

This study was conducted based on a completely randomized design. The data obtained were analyzed using ANOVA (SPSS version 16.0) and if there was a significant effect, the treatment would be carried out with the Dancan test.

Results and discussion

The performance data of broiler chickens treated with nutmeg flesh extract are shown in Table 2. During the rearing period, there was a higher body weight gain ($p<0.05$) in the CTL-, NFE0.5, NFE1.0, and NFE1.5 groups compared to the positive control (CTL^+). Meanwhile, when compared to the negative control (CTL^-; normal density 10 individuals/m2), no significant difference was observed with the treatment of nutmeg flesh extract, either in NFE0.5 or NFE1.0 ($p>0.05$). Several studies have reported that high cage density can interfere with chicken growth and feed efficiency (Lara and Rostagno 2013; Yin et al 2017). The data in this study indicated that the nutmeg flesh extract can reduce the negative impact of farming broilers chickens in high density (16 heads/m2) on the growth performance of broiler chickens.

Table 2. Production traits of broiler chicks fed treatment diets

Items	Dietary groups					SE	*p*
	CTL⁻	CTL⁺	NFE0.5	NFE1.0	NFE1.5		
Initial BW (g)	418.44	419.78	419.21	420.20	420.05	1.38	0.25
Final BW (g)	1720.10^{b}	1596.63^{a}	1714.88^{b}	1756.25^{bc}	1778.13^{c}	73.56	<0.01
Weight gain (g/d)	1301.66^{b}	1176.85^{c}	1295.66^{b}	1336.05^{ab}	1358.08^{a}	73.45	<0.01
Accumulative FI (g/d)	2119.76^{d}	2038.50^{e}	2166.92^{c}	2213.90^{b}	2259.53^{a}	30.36	<0.01
FCR	1.63^{a}	1.73^{b}	1.67^{ab}	1.66^{a}	1.66^{a}	0.05	0.03

^{a,b,c,d} *Means with various letters within the similar row indicate substantial difference. SE: standard error, FI: feed intake, BW: body weight, FCR: feed conversion ratio*

To date, there are no studies that describe the effect of using nutmeg flesh extract on increasing body weight in broiler chickens available in the literature. However, the effectiveness of the nutmeg flesh extract can most likely be attributed to the synergistic action of various phytochemicals present in the nutmeg flesh (Gupta et al 2013; Zakaria et al 2015; Yakaiah et al 2019; Vangoori et al 2019; Adu et al 2020) which in turn improved the physiological conditions in chickens. The latter condition had an impact on increasing feed utilization and efficiency, thereby increasing the growth performance of broiler chickens. Phytochemicals such as flavonoids, phenols, and saponins have been reported to promote higher growth rates and better feed efficiency in broiler chickens due to their ability to scavenge free radicals and maintain intestinal mucosal integrity (Oloruntola et al 2019). In addition, previous studies have shown that the nutmeg flesh has antibacterial, antiparasitic, antifungal, anti-coccidiosis, and hepatoprotective properties (Olaleye et al 2006; Panggabean et al 2019) which can stimulate the growth of beneficial bacteria, deactivate pathogenic bacteria, and accelerate nutrient metabolism and absorption in the digestive tract which in turn can improve the growth performance of broiler chickens (Dhama et al 2015). The improvement in feed conversion observed in broilers fed with nutmeg flesh showed evidence of better feed utilization than the positive control group (CTL^{+}). Other studies have shown that the use of plants as phytogenic in broiler chicken feed can increase intestinal digestibility, which in turn increases the growth of broiler chickens (Amad et al 2011).

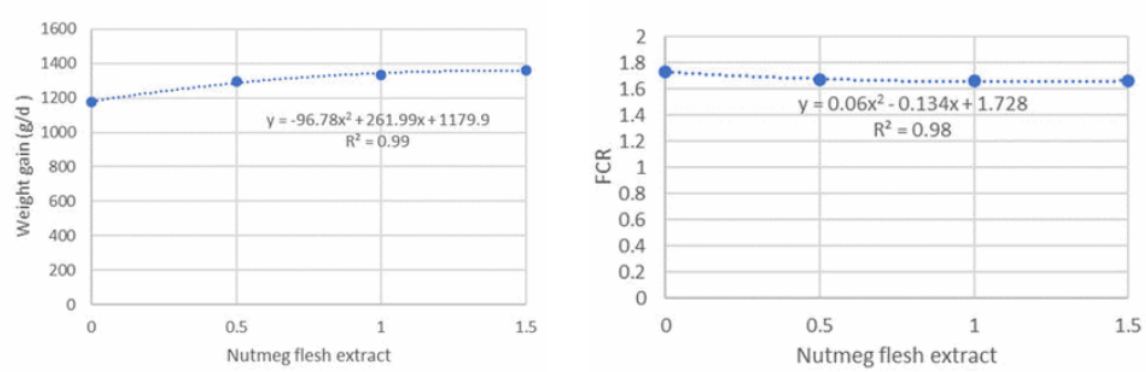

Figure 2. Effect of level nutmeg flesh extract on weight gain and FCR in broiler chickens

Regarding feed consumption, it was observed that the provision of nutmeg flesh extract led to higher feed consumption (p<0.05) during rearing. The provision of nutmeg flesh extract can increase feed consumption, which in turn can increase body weight. Plants from the essential oil group have been reported to improve the taste and delicacy of feed and increase feed consumption and weight gain (Windisch et al 2008; Sugiharto 2016). Nutmeg flesh contains about 10% essential oil, which mainly consists of terpene hydrocarbons (sabinene and pinene), myrcene, phellandrene, camphene, limonene, terpinene, myrcene, pcymene, and other terpene derivatives (Jaiswal et al 2009; Nagja et al 2016).

The results of this study showed that giving nutmeg flesh extract to broiler chickens raised at high density had no effect (p >0.05) on the internal organ weight of broiler chickens (Table 3). Regarding the use of herbal plants in feed, Martínez et al (2021) stated that giving cashew (*Anacardium occidentale* L.) leaf flour to the ration did not affect the relative weight of the internal organs of broiler chickens. In line with this, Toghyani et al (2011) and Mareta et al (2020) showed no impact of giving cinnamon, garlic, and starflesh on the relative weight of the internal organs of broiler chickens.

Table 3. Organs weight of broiler chicks fed treatment diets

Items	Dietary groups					SE	*p*
(% live weight)	CTL$^-$	CTL$^+$	NFE0.5	NFE1.0	NFE1.5		
Liver	2.45	2.46	2.53	2.56	2.53	0.30	0.98
Heart	0.46	0.47	0.45	0.46	0.46	0.03	0.98
Proventriculus	0.43	0.49	0.46	0.46	0.47	0.04	0.36
Gizzard	1.52	1.48	1.61	1.59	1.43	0.14	0.30
Pancreas	0.25	0.26	0.25	0.30	0.24	0.06	0.55
Spleen	0.08	0.13	0.08	0.07	0.07	0.05	0.35
Thymus	0.16	0.14	0.15	0.15	0.14	0.04	0.97
Bursa Febricus	0.08	0.08	0.08	0.11	0.11	0.04	0.92
Duodenum	0.48	0.56	0.49	0.45	0.55	0.08	0.14
Jejenum	1.11	1.20	1.11	1.12	1.11	0.16	0.89
Ilium	0.70	0.80	0.54	0.68	0.52	0.23	0.27
Cecum	0.64	0.61	0.79	0.69	0.83	0.18	0.24
Abdominal fat	1.45	1.65	1.43	1.28	1.17	0.31	0.16

SE: standard error

Table 4. Carcass traits of broiler chicks fed treatment diets

Items	Dietary groups					SE	*p*
	CTL$^-$	CTL$^+$	NFE0.5	NFE1.0	NFE1.5		
	(% live weight)						
Carcass	69.43	69.17	68.43	68.66	68.54	1.98	0.93
	(% eviscerated carcass)						
Breast	39.51	39.40	36.30	39.05	39.06	2.74	0.33
Upper thigh	15.86	15.93	15.70	15.91	15.18	0.85	0.65
Lower Thigh	12.66	13.43	13.81	13.28	13.88	1.07	0.41
Wings	7.29	7.33	7.40	7.19	7.44	0.51	0.66
Back	21.47	20.63	22.09	21.29	21.33	1.37	0.61
Abdominal fat	2.08	2.38	2.09	1.87	1.72	0.46	0.21

SE: standard error

The results showed that the addition of nutmeg flesh extract in broiler chickens maintained at high density had no effect (p>0.05) on the percentage of carcass and commercial pieces of broiler carcass (Table 4). This shows that giving nutmeg flesh extract does not have a detrimental effect on the characteristics of broiler chicken carcass. This finding is in line with Vase-Khavari et al (2018) study which used three types of medicinal plants, i.e. *Rhus coriaria*, *Heracleum persicum*, and *Mentha peperita*. Their study found no differences in the characteristics of broiler chicken carcasses. However, Mashayekhi et al (2018) informed the opposite that there was an increase in carcass yield when using *Eucalyptus globulus* leaves as a feed supplement for broiler chickens. In general, several factors that can affect the carcass characteristics of broiler chickens include genetics, gender, physiological status, age, final weight, and feed quality (Hidayat et al 2017).

Conclusion

- The provision of nutmeg flesh extract improved the performance of broiler chickens raised at high stocking density and did not have a detrimental effect on the carcass characteristics of broiler chickens.

References

Abudabos A M, Samara S M, Hussein E O S, Al-Ghadi M Q and Al-Atiyat R M 2013 Impacts of stocking density on the performance and welfare of broiler chickens. Italian Journal of Animal Science, 12.e11. https://doi.org/10.4081/ijas.2013.e11

Adu O A, Gbore F A, Oloruntola O D, Falowo A B and Olarotimi O J 2020 The effects of Myristica fragrans seed meal and Syzygium aromaticum leaf meal dietary supplementation on growth performance and oxidative status of broiler chicken. Bulletin of the National Research Centre, 44:149. https://doi.org/10.1186/s42269-020-00396-8

Agbogidi O M and Azagbaekwe O P 2013 Health and nutritional benefits of nutmeg (*Mystica fragrans* houtt). Scientia Agriculturae 1(2):40–44.

Amad A A, Männer K, Wendler K R, Neumann K and Zentek J 2011 Effects of a phytogenic feed additive on growth performance and ileal nutrient digestibility in broiler chickens. Poultry Science, 90:2811–2816. https://doi.org/10.3382/ps.2011-01515

Assa J R, Simon B, Widjanarko, Joni K and Siegfried B 2014 Antioxidant Potential of Flesh, Seed and Mace of Nutmeg (*Myristica fragrans* Houtt). International Journal of ChemTech Research, 6 (4) : 2460-2468

Bolton W 1967 Poultry nutrition. MAFF Bulletin No.174, HMSO, London

Dhama K, Latheef S K, Mani S, Samad H A, Karthik K, Tiwari R, Khan R U, Alagawany M, Faraq M R, Alam G M, Laudadio V, and Tufarelli V 2015 Multiple beneficial applications and modes of action of herbs in poultry health and production—a review. International Journal of Pharmacology, 11:152–176. https://doi.org/10.3923/ijp.2015.152.176

Estevez I 2007 Density allowances for broilers: where to set the limits?, Poultry Science, 86: 1265-1272. https://doi.org/10.1093/ps/86.6.1265

Feddes J J R, Emmanuel E J and Zuidhoft M J 2002 Broiler performance, bodyweight variance, feed and water intake, and carcass quality at different stocking densities. Poultry Science, 3 : 774-779. https://doi.org/10.1093/ps/81.6.774

Gupta A, Bansal V and Babu V 2013 Chemistry, antioxidant and antimicrobial potential of nutmeg (*Myristica fragrans* Houtt). Journal of Genetic Engineering and Biotechnology, 1(11):25-31. https://doi.org/10.1016/j.jgeb.2012.12.001

Hidayat M, Zuprizal Z, Sundari S, Kurniawati A, Wati AK, Kusmayadi A 2017 The effect of liquid tumeric extract supplementation on carcass production and chemical quality of broiler meat. Journal of the Indonesian Tropical Animal Agriculture, 42:6-13. https://doi.org/10.14710/jitaa.42.1.6-13

Jaiswal P, Kumar P, Singh V K and Singh D K 2009 Biological effects of *Myristica fragrans*. Annual Review of Biomedical Sciences,11:21-29.

Klarik, G, Klarik Z, Grcevi C and Hanzek M D 2018 Quality of chicken meat. In Book: Animal Husbandry and Nutrition. https://doi.org/10.5772/intechopen.72865

Kridtayopas C, Rakangtong C, Bunchasak C and Loongyai W 2019 Effect of prebiotic and synbiotic supplementation in diet on growth performance, small intestinal morphology, stress, and bacterial population under high stocking density condition of broiler chickens. Poultry Science, 98 (10): 4595–4605. https://doi.org/10.3382/ps/pez152

Lara L J and Rostagno M H 2013 Impact of heatstress on poultry production. Animals, 3(2): 356-369. https://doi.org/10.3390/ani3020356

Mareta I, Nathaniel G, Yudiarti T, Widiastuti E, Wahyuni H I, Sugiharto S 2020 Effect of *Averrhoa bilimbi* fruit filtrate and Shrimp paste mixture on performance, gut microbes and blood profile of broilers. Indonesian Journal of Animal and Veterinary Sciences, 25(4):182-189. https://dx.doi.org/10.14334/jitv.v25i4.2515

Mashayekhi H, Mazhari M, Esmaeilipou O 2018 Eucalyptus leaves powder, antibiotic and probiotic addition to broiler diets:effect on growth performance, immune response, blood components and carcass traits. Animal,12(10):2049-2055. https://doi.org/10.1017/S1751731117003731

Martínez Y, Tobar LA, Lagos H M, Parrado CA, Urquía A M and Valdivié M 2021 Phytobiotic Effect of *Anacardium occidentale* L. Leaves Powder on Performance, Carcass Traits, and Intestinal Characteristics in Broilers. Brazilian Journal of Poultry Science , 23 (1):1-10. https://doi.org/10.1590/1806-9061-2020-1362

Morita T, Jinno K, Kawagishi H, Arimoto Y, Suganuma H, Inakuma T, Sugiyama K 2003 Hepatoprotective effect of myristicin from nutmeg (*Myristica fragrans*) on lipopolysaccharide/d-galactosamine-induced liver injury. Journal of Agricultural and Food Chemistry, 51(6): 1560 -1565. https://doi.org/10.1021/jf020946n

Mtileni B J, Nephawe K A, Nesamvuni A E and Benyi K 2007 The influence of stocking density on body weight, egg weight, and feed intake of adult broiler breeder hens. Poultry Science, 86:1615–1619. https://doi.org/10.1093/ps/86.8.1615

Nagja T, Vimal K and Sanjeev A 2016 *Myristica fragrans* : a comprehensive review. International Journal of Pharmacy and Pharmaceutical Sciences, 8 (2): 27-30

Olaleye M T, Akinmoladun A C and Akindahunsi A A 2006 Antioxidant properties of *Myristica fragrans* (Houtt) and its effect on selected organs of albino rats. African Journal of Biotechnology. 5(13):1274–1278

Oloruntola O D, Ayodele S O, Adeyeye S A, Jimoh A O, Oloruntola D A and Omoniyi S I 2019 Pawpaw leaf and seed meals composite mix dietary supplementation: effects on broiler chicken's performance, caecum microflora, and blood analysis. Agroforestry Systems, 94:555–564. https://doi.org/10.1007/s10457-019-00424-1

Panggabean K A, Rusmarilin H and Suryanto D 2019 The utilization of nutmeg seed (*Myristica fragrans* Houtt) extract as an antimicrobial on tempeh sausage. IOP Conference Series: Earth and Environmental Science, 260:012087

Periasamy G, Karim A, Gibrelibanos M, Gebremedhin G and Gilani A 2016 Nutmeg (*Myristica fragrans* Houtt) oils. In: Preedy V R (Ed.), Essential oils in food preservation, flavour, and safety. Academic Press, First Edition, Chapter 69, pp. 607-616.

Reddy D M, Reddy, G V and Mandal P K 2018 Application of natural antioxidants in meat and meat products-a review. Food and Nutrition Journal: FDNJ-173. https://doi.org/10.29011/2575-7091. 100073

Salami S A, Majoka M A, Saha S, Garber A and Gabarrou J F 2015 Efficacy of dietary antioxidants on broiler oxidative stress, performance and meat quality: science and market. Avian Biology Research, 8: 65-78. https://doi.org/10.3184/175815515X14291701859483

Sugiharto S 2016 Role of nutraceuticals in gut health and growth performance of poultry. Journal of the Saudi Society of Agricultural Sciences, 15: 99–111. https://doi.org/10.1016/j.jssas.2014.06.001

Sugiharto S, Yudiarti T, Isroli I, Widiastuti E, Wahyuni H I and Sartono T A 2019 Feeding fermented mixture of cassava pulp and *moringa oleifera* leaf meal: effect on growth, internal organ and carcass of broiler chickens. Agriculturae conspectus scientificus, 85 (1): 87-93

Taghvaei M, and Jafari S M 2015 Application and stability of natural antioxidants in edible oils in order to substitute synthetic additives. Journal of Food Science and Technology, 52: 1272-1282. https://doi.org/10.1007/s13197-013-1080-1

Tarakdjian J, Capello K, Pasqualin D, Cunial G, Lorenzetto M, Gavazzi L, Manca G and Martino G D 2020 Antimicrobial use in broilers rerared at different stocking densaities: A retrospective study. Animals. 10, 1751. https://doi.org/10.3390/ani10101751

Toghyani M, Toghyani M, Gheisari A, Ghalamkari G and Eghbalsaied S 2011 Evaluation of cinnamon and garlic as antibiotic growth promoter substitutions on performance, immune responses, serum biochemical and haematological parameters in broiler chicks. Livestock Science,138: 167-173. https://doi.org/10.1016/j.livsci.2010.12.018

Vangoori1 Y, Dakshinamoorthi A and Kavimani S 2019 Effect of Myristica Fragrans Extract on Lipid Profile, Glucose, Body Weight, Food Intake, Liver and Renal Functions in Experimental Obese Rats. Biomedical and Pharmacology Journal, 12(2):677-682. https://dx.doi.org/10.13005/bpj/1688

Vase-Khavari K, Mortezavi S H, Rasouli B, Khusro A, Salem A Z, Seidavi A 2019 The effect of three tropical medicinal plants and superzist probiotic on growth performance, carcass characteristics, blood constitutes, immune response, and gut microflora of broiler. Tropical Animal Health and Production, 51(1):33-42.

Windisch W, Schedle K, Plitzner C, Kroismayr A 2008 Use of phytogenic products as feed additives for swine and poultry. *Journal of Animal Science*, 86 : E140–E148. https://doi.org/10.2527/jas.2007-0459

Yin L Y, Wang Z Y, Yang H M, Xu L, Zhang J and Xing H 2017 Effects of stocking density on growth performance, feather growth, intestinal development, and serum parameters of geese. Poultry Science, 96(9):3163-3168. https://doi.org/10.3382/ps/pex136

Zakaria MPM, Abas F and Rukayadi Y 2015 Effects of Myristica fragrans Houtt. (Nutmeg) extract on chemical characteristics of raw beef during frozen storage. International Food Research Journal, 22(3):902–909.

Zhou Y, Mao S And Zhou M 2019 Effect of the flavonoid baicalein as a feed additive on the growth performance, immunity, and antioxidant capacity of broiler chickens. Poultry Science, 98(7):2790-2799. https://doi.org/10.3382/ps/pez071

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