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Scientific Papers. Series D. Animal Science. Vol. LXV, No. 1, 2022
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

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Abstract

This study was conducted to investigate the carcass and cutting yields, meat qualitative traits and sensory evaluation of broiler chickens fed diet contain clove and treated of carrot in drinking water. A total of 200 D.O.C of broilers were used. The experiment utilized a completely randomized design with 4 treatments and 5 replications. Treatments were carrot juice consist of 0, 10, 20, 30 ml/liter water, respectively. Based diet consist of commercial diet 73%, corn 23%, clove meal 1%, and palm oil 3%. Results showed that water intake was significantly decreased, carcass weight, slaughter weight cutting yield, and giblet were non significantly difference but gizzard was significantly increased. Blood triglyceride was non significantly difference, HDL-cholesterol was significant increased, LDL-cholesterol, blood glucose and SGOT were significantly decreased. Cooking loss, WHC and water content of meat were non significantly difference and tenderness was significantly decreased. The color, aroma, texture and taste of meat were non significantly difference. It can be concluded that carrot juice in drinking water could be acceptable up to 30 ml per liter water when given to broiler chickens fed diet contain clove meal.

Key words: *broiler chickens, carrot, clove, drinking water, meat.*

INTRODUCTION

In recent years, poultry welfare and food safety have become a priority for poultry producers, because more and more consumers prefer products from animals raised in free-range or organic farming systems, which they believe provide more convenience and guarantee safe and healthy food products. In addition to prebiotics, probiotics and organic acids, there is increasing interest in preparations of plant origin (phytobiotics), which are considered natural and safe additives characterized by their positive effects on animals, such as antioxidants, antibacterial, antiviral, antifungal, immunostimulants, and stimulating the secretion of digestive enzymes. In view the above, it is necessary to conduct research to test the hypothesis whether herbal diet or external access has a positive effect on the quality of broiler meat.

Herbs are also natural immunostimulants (Nasir & Grashorn, 2010). The positive effect on the health status of poultry is also produced by hypocholesterolemic herbs, as in essential oils in plants were found to inhibit the activity of a liver enzyme (HMG-CoA reductase) which regulates the amount of cholesterol synthesized and thereby reduces its level in the blood (Bölükbaşı et al., 2008). Stimulation of the immune system and antioxidant defense in poultry has become a topical issue since the introduction of the prohibition on the use of antibiotics as growth promoters in animal feed. The use of alternative feed additives that promote animal growth without negative side effects such as antibiotic resistance from pathogenic strains is being taken into account. Herbs and spices contain many active ingredients that can exert various bactericidal, immunomodulatory and antioxidant effects on animals, and ultimately can affect the health status and productivity of animals as well as the quality of animal products (Madhupriya et al., 2018).

Carrot (*Daucus carota*), from the Apiacea family, is a commonly consumed vegetable that grows in temperate climates in Europe, Asia and Africa (Hammam, 2014). Carrot meal has been tested for its potential as a food ingredient in the livestock industry (Steenfeldt et al., 2007). There were many contain active ingredients such as steroids, tannins, flavonoids, and carotenes (Vasudevan et al., 2006; Jasicka-Misiak et al., 2005). According to Febrina (2012) carrots have high content α- and β-carotene, both types of carotene are important in nutritional needs as provitamin A. In addition to the high content of provitamin A, carrots also contain vitamin C and vitamin B and contain minerals, especially calcium and phosphor. Vitamin A in carrots has functions for cell differentiation, digestion, immunity and increasing feed efficiency. Calcium plays a role in various stages of metabolism, especially as a cofactor in enzyme activity. The balance of calcium and other mineral ions in the body is necessary for the regulation of enzyme activity. Calcium as a catalyst for biological reactions such as absorption of B vitamins which are used for protein metabolism.

Al-Snafi (2017) stated in his reviewed article that nutritional analysis of carrot juice showed protein 1.067%, crude fat 0.367%, crude fibre 1.167%, carbohydrates 6.100 %, many vitamins and minerals, such as: ascorbic acid 16.667 mg/100 g, Ca++ 55.000 mg/100 g, Fe++ 1.667 mg/100 g, PO4 44.333 mg/100 g, thiamine 0.057 mg/100 g, niacin 0.300 mg/100 g, riboflavin 0.100 mg/100 g, β-carotene 2730, and vitamin A 2805. The pharmacological studies revealed that the plant possessed cytotoxic, antioxidant, antidiabetic, antimicrobial, smooth muscle relaxant, hypotensive effect and decrease intraocular pressure, gastro-protective, nephro-protective, hepato-protective, cardio-protective anti-depressant memory enhancement, anti-inflammatory, reproductive, wound healing and hear induction and many other effects. Sahin et al. (2009) stated that vitamin A plays a role in several body functions, including the differentiation of digestive epithelial cells and has an effect on the immune function of poultry, as well as being able to increase feed efficiency and increase body weight. The calcium content in carrots is quite high which functions as a coenzyme in protein metabolism.

Arkoub-Djermoune et al. (2020) reported about two varieties of carrot that determined before storage of the samples and after storage every three days: after 3, 6, 9, and 12 days, that the Touchon variety is richer in phenolics, flavonoids, and carotenoids and presents higher antioxidant activity in comparison with the Supermuscade variety. At the end of storage, the bioactive compound content and antiradical activity increased significantly. Also, an extremely significant correlation was observed between the antioxidant contents and the antioxidant capacities of aqueous carrot extracts.

Suplementation dried carrot waste up to 5% in broiler diets enhanced the productive performance and economic efficiency (Hashem, 2012). Muzaki et al. (2017) stated the use of waste carrot meal more than 4% reduced body weight, but were not significantly different in feed consumption and feed conversion ratio. The use of carrot waste in broiler diets should not be more than 2%. A mixture of carrot and fruit waste juices can be used up to 20% in broiler diet replacing 40% of maize effectively. The high crude fiber content in mixed carrot and fruit waste juices limited their use in broiler feeds (Rizal et al., 2010).

The use of carrot waste meal up to 6% in the ration did not affect protein consumption and protein efficiency ratio, but it could increase calcium retention. Therefore, carrot waste meal can be used as feed for broiler chickens (Prasetyo et al., 2018). Addition of cold-press carrot seed oil to the basal diet increased weight gain, hot carcass weight and carcass yield, and had resulted in positive changes on lactic acid bacteria count and breast tissue shelf life. As a result, carrot seed oil can be added in the diet of broilers as a beneficial dietary source of natural antioxidant for broilers (Ürüşan et al., 2018). Dried carrot meal prepared from fresh carrots was found to be a good source of xanthophyll (54 g/kg), a moderate source of protein (188.3 g/kg) and energy (2510 kcal/kg) with a low fiber content (80 g/kg). The use of 8% dry carrot meal added in the based diet significantly improved egg yolk color, and 4% dried carrot meal increased egg yolk score, however, weight gain, egg production and feed conversion were not significantly affected by the addition of dried carrot meal in diet of laying hen (Sikder et al., 1998).

Supplementation carrot meal 20-100 g per kg dry matter of feed did not affect the growth rate, live weight and carcass characteristics of female broiler chickens aged 22-42 days, but increased feed consumption, feed conversion ratio, metabolic energy consumption and nitrogen retention (Ng'ambi et al., 2019). Carrots are one of the potential and multipurpose horticultural commodities in livestock as a source of feed. Supplementation of carrot tuber juice 12.5 ml/head/day increased the daily average body weight gain of broiler chickens (Paramita et al., 2019).

Clove (*Syzygium aromaticum*; synonym: *Eugenia cariophylata*), is a plant from the Myrtaceae family native to the Maluku islands in Eastern Indonesia (Kamatou et al., 2012). Cloves are aromatic flower buds from an evergreen tree (Mbaveng and Kuete, 2017), considered a spice, contain 10% essential oil which is mostly eugenol, a substance that has an anesthetic effect (Prashar et al., 2006), also contains vitamins B and C (Merrill and Perry, 2009). Vitamin C is involved in the synthesis of stress hormones so that it has a major role in lowering body temperature by increasing heat dissipation through the blood vessels that surround the body to maintain a relatively constant temperature (Cheng, 1990). Cloves contain phenolic compounds that are antibacterial (Dorman & Dean, 2000).

Consumer refusal to synthetic additives has increased in recent times (Kirkpinar et al., 2014). Therefore, supplementation of poultry diet with natural components to increase production has been widely applied in the world (Abou-Elkhair et al., 2020). Consequently, herbaceous spices and their bioactive constituents are becoming important in poultry production due to their valuable impact on growth, production, immune status and meat quality without leaving residues on the product or rearing environment (Hussein et al., 2020; Abd El-Hack et al., 2016).

Final body weight and weight gain of rats were not significantly different between treatments. Administration of conventional emulsion of clove essential oil, clove oil microemulsion, or eugenol microemulsion resulted in significant improvement in fatty liver inflammation (steatohepatitis) and dyslipidemia with consequent prevention of cardiovascular disease and other complications of steatohepatitis (Al-Okhbi., 2014). Clove, and its essential oil, is one of the plant extracts found useful in poultry to improve growth performance by enhancing the intestinal microbiota population (Mohammadi et al., 2014). Supplementation of 450 ppm clove essential oil in broiler ration significantly increased body weight gain and feed conversion ratio during the experimental period (0-42 days) and decreased total cholesterol composition at 21 days of age. Clove essential oil can be considered as a potential growth promoter for poultry (Mehr et al., 2014).

The most common product from a chicken slaughterhouse is a whole chicken. However, in recent years there has been a shift from sales of whole chickens to sales of cut chicken parts and convenience products as these products have a higher value (FAO, 2010). Breast meat makes up about 30% of the edible carcass meat and 50% of the edible protein (Summers et al., 1988). The criteria for breast meat quality include color, pH, water holding capacity, tenderness, and sensory acceptance (Barbut, 2009; Van Laack et al., 2000). The quality of broiler meat is a major issue for the poultry industry.

There is very little information available in the literature on the use of carrot juice in drinking water and the formulation of diets containing cloves, therefore, the aim of the present study was to determine the effect of water supplementation with carrot juice on carcass and cutting yields, meat qualitative traits and sensory evaluation of broiler chickens fed diet contain clove and for the reason of improving chicken welfare and food product safety.

MATERIALS AND METHODS

The study was conducted using 200 of one-day-old broiler chickens. Treatments were carrot juice consist of 0, 10, 20, 30 ml/liter water, respectively and the diets formula shown in Table 1. Feed and water were provided *ad libitum*. The preparation of carrot juice based on Alom (2013). Carrots were cleaned, cut into small pieces and added with water in a ratio of 1:10, and then was blended, stored in the refrigerator at a temperature of 4°C to retain the active ingredients of the juice.

The variables measured were carcass and cutting yields, giblet, blood lipid profiles, physical traits and sensory evaluation of meat: cooking loss, water holding capacity, water content and tenderness of meat; colour, aroma, texture and taste of meat. At the end, d-35 of the experiment 5 birds per treatment were randomly selected and processed to determine processing yields. Birds were weighed, killed by cervical dislocation after 9 h of feed and water deprivation, bled, scalded, and defeathered. Data from carcass weight, cut parts (breast, wings, leg, thighs and drumsticks) and internal organ (liver, heart, gizzard, spleen, bile) were recorded.

The value of carcass percentage was obtained by comparing the weight of the carcass (g) with the slaughter weight (g) multiplied by 100%. Water holding capacity was determined by the method of Hamm, cooking loss, and tenderness of the meat with the shear press method, as a modified Warner-Bratzler method as reported by Soeparno (2011). Meat sensory tests were conducted with a sample of meat that had been cooked without salt or spices. Testing was undertaken using the meat sensory panelists, including as many as 35 individuals who are not trained with the scoring method. Each panelist evaluated the samples presented to them at random, and evaluated color, aroma, texture and taste. All sensory attributes were scored on a scale ranging from 1 (least intense) to 7 (most intense).

Tabel 1. Composition and Nutrients Content of the Diets

Feedstuff	2-3 Weeks	4-5 Weeks
Commercial Diet 1 (%)	73	0
Commercial Diet 2 (%)	0	73
Corn (%)	23	23
Clove Meal	1	1
Coconut Oil (%)	3	3
Total	100	100
Chemical Composition:		
Crude Protein (%)	19.82	17.09
Crude Fiber (%)	3.37	3,10
Fat (%)	3.01	2.83
Ca (%)	5.25	1.79
P (%)	0.57	0.25
GE (Kcal/kg)	4153.52	4054.05
ME (Kcal/kg)	3115.14	3040.54

This study used a completely randomized one-way design (CRD) (Steel and Torrie, 1982) consisting of 4 treatment and 5 replications. Data for all parameters were subjected to an analysis of variance. The treatments mean with significant differences at $P<0.05$ were compared using Duncan's Multiple Range Test. The data was then analyzed using IBM SPSS 24 software.

RESULTS AND DISCUSSIONS

Results showed that water intake was significantly decreased, and carcass weight, slaughter cutting yield weight (Table 2), and internal organ were non significantly difference but gizzard (Table 3) was significantly increased. Blood triglyceride was non significantly difference, HDL-cholesterol was significantly increased, LDL-cholesterol, blood glucose and SGOT (Table 4) were significantly decreased. Cooking loss, WHC and water content of meat (Table 5) were non significantly difference but tenderness was significantly decreased. The color, aroma, texture and taste of meat (Table 5) were non significantly difference.

Water quality has the potential to affect digestion and absorption of nutrients, as well as flock health. Because of its hydrogen bonding capabilities, water is a universal solvent and, as a result, may contain numerous dissolved minerals and other compounds. Water intake in birds were roughly twice the weight of feed intake. However, during periods of extreme heat stress, water intake may triple or even quadruple. Pesti et al. (1985) reported that chickens will consume drinking water twice or more than feed intake. Although it varied, the proportion of water: feed = 2 : 1, especially in summer.

Water intake in this study (Table 2) was lower than the standard broiler drinking water intake (around 190 ml/head/day in the 3^{rd} and 4^{th} weeks) (Lesson and Summer, 2005) when treated by carrot juice 10-30 ml. The addition of 20% of carrot juice and more caused the decreasing of drinking water. This may be due to a slightly bitter taste in drinking water because of the tannin content so that chickens do not like it.

Serrano et al. (2013) observed an increased water intake with pelleted diets compared to mash diets, whereas water to feed ratio was not affected. Water intake is highly correlated with the quality and amount of feed consumed by chickens, and also with poultry age, body weight, environmental temperature, and others (May et al., 1997).

Table 2. Effect of Carrot Juice in Drinking Water on Carcass and Cutting Yields

Variables	Treatments in Drinking Water				SEM	p Value
	0 ml CJ	10 ml CJ	20 ml CJ	30 ml CJ		
Water Intake, ml, head^{-1} day^{-1}	195.14^{b}	186.54^{b}	177.23^{ab}	163.96^{ab}	4.2	0.03
Total Water Intake, ml, head^{-1}	5463.76^{b}	5222.96^{b}	4962.36^{ab}	4602.08^{a}	115.2	0.04
Feed Intake, g, head^{-1} day^{-1}	79.75^{ab}	84.72^{c}	80.13^{ab}	78.37^{a}	1.1	0.11
Slaughter Weight, g^{ns}	1512.8	1532.0	1451.40	1442.60	21.3	0.38
Carcass Weight, g^{ns}	1063.40	1082.00	1047.80	1010.00	16.9	0.52
Left Breast, % ^{ns}	14.64	15.41	14.41	14.76	0.29	0.67
Right Breast, % ^{ns}	14.17	15.20	14.49	14.10	0.27	0.50
Left Thigh + Drumstick, % ^{ns}	16.12	16.15	15.93	16.33	0.17	0.88
Right Thigh + Drumstick, % ^{ns}	16.51	16.24	15.95	16.47	0.16	0.62
Left Wing, % ^{ns}	5.20	5.29	5.16	5.32	0.07	0.84
Right Wing, % ^{ns}	5.22	5.58	5.21	5.30	0.10	0.63
Leg, % ^{ns}	6.56	6.57	6.35	7.40	0.19	0.20

^{CJ}carrot juice; ^{ns}non significant; ^{abc}different superscript at the same raw indicated significantly different ($P<0.05$).

The carcass traits of broilers such as carcass yield and cutting yield were tested. Analysis of variance showed no significant differences in relative weight of breast, thigh + drumstick, wing, and leg among experimental groups. As illustrated in Table 2, no notable difference in carcass was revealed between groups. The present results of carcass were in agreement with those noticed by several researchers who noted that the addition of lime juice in drinking water at the level of 1% was able to reduce abdominal fat without affecting the appearance of the carcass (Rakhamansyah et al., 2019). The use of betel leaf extract up to a level of 2% in drinking water did not affect the final weight, carcass percentage and abdominal fat of broiler chickens slaughtered at the age of five weeks (Pahlepi et al., 2015). On the contrary with Haroen and Budiansyah (2018) stated that the use of fermented ginger (*Zingiber officinale*) extracts in the drinking water up to 8 ml increase the carcass quality dan feed intake but decreased cholesterol carcass dan abdominal fat of broiler chicks.

Carrot juice supplementation had no effect on carcass, breast, thigh+drumstick, wing, leg, liver, heart, spleen, but gizzard and bile weights of broiler chickens. It is interesting to notice that, gizzard weight (%) was significantly decreased when drink 10 ml carrot juice compared to control, however, significantly increased with increasing the level of carrot juice till 30 ml in broiler drinking water (Table 3). These results agreed with those of Abdel-Azeem & Hemid (2006) who found a gradual decrease in the abdominal fat, gizzard fat and total non-carcass fat, while the relative weight of gizzard was increased by increasing barley radicel levels in the broiler diets. Ürüşan et al. (2018) reported increase in hot carcass weight and carcass yield of broiler chickens feed carrot seed oil indicated that increase carcass weights occurred because of the appetizer properties of plant extracts by increasing the gastric digestion liquor.

Table 3. Effect of Carrot Juice in Drinking Water on Internal Organ

Variables	Treatments in Drinking Water				SEM	p Value
	0 ml CJ	10 ml CJ	20 ml CJ	30 ml CJ		
Liver (%)^{ns}	1.75	1.51	1.59	1.56	.06	.52
Gizzard (%)	1.38^{ab}	1.30^{a}	1.34^{ab}	1.55^{b}	.04	.09
Heart (%)^{ns}	0.46	0.43	0.48	0.53	.02	.19
Spleen (%)^{ns}	0.09	0.09	0.09	0.10	.01	.90
Bile	0.16^{b}	0.13^{ab}	0.15^{ab}	0.10^{a}	.01	.08

^{CJ}carrot juice; ^{ns}non significant; ^{abc}different superscript at the same raw indicated significantly different ($P<0.05$).

In this study, blood triglyceride was non significantly difference, HDL-cholesterol was significantly increased, LDL-cholesterol, blood glucose and SGOT (Table 4) were significantly decreased. Sigolo et al. (2021) reported that dietary supplementation with thyme extract at 300 mg/L drinking water level improved broiler chicken carcass traits in terms of carcass and drumsticks yields, and blood serum parameters such as total protein, albumin, urea, total cholesterol and HDL.

Table 4. Effect of Carrot Juice in Drinking Water on Serum Biochemical

Blood Lipid Profiles	Treatments in Drinking Water				SEM	P Value
	0 ml CJ	10 ml CJ	20 ml CJ	30 ml CJ		
Triglyceride, mg.dL^{-1} ^{ns}	62.5	41.8b	47.2	45.5	3.6	.19
Total Cholesterol, mg.dL^{-1}	136.5^{ab}	158.0^{c}	131.5^{a}	150.0^{bc}	3.32	.006
HDL-Cholesterol, mg.dL^{-1}	96.0^{a}	114.0^{b}	107.5^{b}	108.5^{b}	1.78	.000
LDL-Cholesterol, mg.dL^{-1}	25.0^{b}	33.0^{d}	18.5^{a}	30.0^{c}	1.31	.000
SGOT, mg.dL^{-1}	206.0^{bc}	210.5^{c}	195.5^{ab}	185.5^{a}	3.09	.008
Blood Glucose, mg.dL^{-1}	219.0^{b}	223.0^{b}	210.0^{a}	207.0^{a}	1.69	.000

^{CJ}carrot juice; ^{ns}non significant; $^{a-d}$different superscript at the same raw indicated significantly different (P<0.05).

The effect of the carrot juice in drinking water on sensory evaluation of breast meat of broiler chicken was shown in Table 5.

Table 5. Effect of Carrot Juice in Drinking Water on Physical and Sensory Evaluation of Meat

Variables	Treatments in Drinking Water				SEM	P Value
	0 ml CJ	10 ml CJ	20 ml CJ	30 ml CJ		
Cooking Loss (%)^{ns}	22.3	21.7	23.5	23.6	.48	.25
WHC (%)^{ns}	45.5	49.8	47.6	49.0	.84	.11
Water Content (%)^{ns}	64.4	66.5	65.1	64.3	.60	.26
Tenderness (g/cm2)	195.0^{c}	185.0^{a}	195.5^{d}	191.0^{b}	.97	.000
Color	4.67	4.77	4.53	4.53	.059	.44
Aroma	4.93	4.83	5.03	5.10	.079	.66
Texture	5.07	5.07	5.00	5.00	.084	.99
Taste	4.87	5.00	5.00	5.17	.082	.64

^{CJ}carrot juice; ^{ns}non significant; $^{a-d}$different superscript at the same raw indicated significantly different (P<0.05).

There was no significant difference in taste, aroma, texture, and color. Soeparno (2011) stated that an important sensory quality element for processed meat is the appearance of meat color. Even though the smell, taste and texture are attractive, if the color display is not attractive then the taste for the food will be reduced. The color of chicken meat is white, because the concentration of myoglobin in the muscles is about 0.025%. Chicken meat is very unique, because it has a striking color difference. The normal color of raw breast meat is pale pink, while the thighs and drumstick are dark red. Kristensen et al. (2002) found a relationship between diet and texture of meat. Also, Cisneros et al. (1996) and Smith et al. (2002) reported a relationship between feed and the colour of meat. The main differences in meat quality between free-range and conventionally-reared chickens are related to colour, flavour, and texture. However, breast meat yield was little affected by diet composition (Summers et al., 1988).

Carrot juice supplementation affected tenderness broiler chicken meat. The carrot juice in drinking water had significantly (P<0.01) effect the tenderness value when compared to control. Supplementation 20 ml of carrot juice improved meat tenderness. Meat physical attribute values of cooking loss, WHC, and water content on meat (Table 5) were not affected by the carrot juice in which no significant difference (P>0.05) was observed between the dietary groups when compared to control.

CONCLUSIONS

Carrot juice supplementation did not have any effect on slaughter weight, carcass weight, carcass cutting, meat cooking loss, WHC, and water content but tenderness of broiler chickens. Carrot juice supplementation decreased water intake and feed intake of female broiler chickens. As a result, carrot juice can be added in the drinking water of broilers as a beneficial feedstuff supplement which contains natural antioxidants. Optimal improvements of feed intake, slaughter weight, carcass and tenderness of meat were achieved at different carrot juice supplementation levels. Thus, carrot juice levels for optimal productivity will depend on the parameter in question. This has a lot of implications in drinking water formulations where carrot juice is included.

ACKNOWLEDGEMENTS

The author would like to thanks Ministry of Education, Culture, Research, and Technology for providing financial assistance in this research.

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