Brazilian Journal of Biology®

ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

Original Article

Organoleptic characteristics and compositional profile of meat of growing Japanese quail fed different levels of poultry byproducts compost

Características organolépticas e perfil composicional da carne de codornas japonesas em crescimento, alimentadas com diferentes níveis de composto de subprodutos de aves

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Abstract

The poultry industry generates a lot of waste, including dead birds, manure, and poultry litter. Poultry waste should never be disposed of improperly because it can seriously harm the environment. The waste can be recycled as a feedstock for use in poultry feed by composting the litter and deceased birds. The compositional profile and organoleptic properties of the meat of growing Japanese quail were examined over the course of a 4-week trial to ascertain the effect of adding compost to the diet. In a completely randomized design (CRD), 1200 newly hatched quail chicks (Coturnix coturnix japonica) were divided into five treatment groups (diets with 0, 2.5, 5, 7.5, and 10% compost), each consisting of 40 birds with six replicates. The addition of compost to the diet had no noticeable effects on the organoleptic qualities of appearance, color, aroma, taste, texture, juiciness, tenderness, and acceptability (P>0.05). The compositional profile characteristics for chicks given compost at any level compared to chicks fed the control diet showed no differences (P>0.05). These findings suggest that the sensory characteristics and compositional profile of growing meat quails can be maintained when fed diets including up to 10% compost.

Keywords: compost, quail, sensory quality, compositional profile.

Resumo

A indústria avícola gera muitos resíduos, incluindo aves mortas, esterco e cama de frango. Resíduos de aves nunca devem ser descartados de forma inadequada, pois podem prejudicar seriamente o meio ambiente. Os resíduos podem ser reciclados como matéria-prima para uso na alimentação de aves, compostando a cama e as aves mortas. O perfil de composição e as propriedades organolépticas da carne de codornas japonesas em crescimento foram examinados ao longo de um ensaio de 4 semanas para verificar o efeito da adição de composto à dieta. Em um delineamento inteiramente casualizado (CRD), 1.200 pintos de codorna recém-eclodidos (*Coturnix coturnix japonica*) foram divididos em cinco grupos de tratamento (dietas com 0, 2,5, 5, 7,5 e 10% de composto), cada um composto por 40 aves com seis repetições. A adição de composto à dieta não teve efeitos perceptíveis nas qualidades organolépticas de aparência, cor, aroma, sabor, textura, suculência, maciez e aceitabilidade (P > 0,05). As características do perfil de composição para pintos que receberam composto em qualquer nível comparadas aos pintos alimentados com a dieta controle não mostraram diferenças (P > 0,05). Essas descobertas sugerem que as características sensoriais e o perfil de composição de codornas de corte em crescimento podem ser mantidos quando alimentadas com dietas incluindo até 10% de composto.

Palavras-chave: composto, codorna, qualidade sensorial, perfil composicional.

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Received: June 15, 2023 – Accepted: July 28, 2023

1. Introduction

Due to intense production methods, the poultry industry generates significant amounts of wastes, including dead birds, manure, and poultry litter (Bolan et al. 2010). Unsafe disposal of poultry waste can result in serious pollution and health problems (Kelleher et al., 2002; Sharpley et al., 2007). Waste disposal in pits or lagoons is insufficient and raises major concerns about potential ground water pollution, particularly in regions with high water tables (Wood et al., 2010). On-farm burial is the most simplest and labor-efficient method (Wilkinson, 2011). However, disposal by burial results in issues with the quality of subsurface water (Malone, 2005; CAST, 2008; Bonhotal et al., 2014). Landfill disposal may result in environmental degradation or contamination of the environment and nearby ecosystems (Wilkinson, 2011). Burning is a minimally labor-intensive and biologically safe way to dispose of deceased birds, but it raises serious concerns due to rising fuel prices and stricter air quality restrictions (Blake and Donald, 2002; CAST, 2008; Bonhotal et al., 2014). The main method of carcass disposal has been hauling to a rendering plant. However, there are significant drawbacks to this disposal option, including the investment and running costs of the rendering plants, related transportation costs, and potential disease spread (CAST, 2008; Bonhotal et al., 2014). On-farm freezers have not been widely used in commerce as a preservation method. One potential way to handle chicken waste (litter and dead birds) is to recycle it as a feedstock for use in poultry feed. This might be accomplished by properly composting the litter and dead birds together with proper feed management techniques. One of the various methods that can be used to effectively use litter without affecting the environment is composting dead birds and litter (Kelleher et al., 2002; Kumar et al., 2007).

According to Wilkinson (2011), composting is an aerobic biodegradation process that decreases organic waste and transforms it into a product with added value (Capucille et al., 2002; Michel Junior et al., 2002; Ryckeboer et al., 2003; Charnay, 2005; Turan, 2009). In the composting process, naturally occurring, advantageous microorganisms in the poultry litter, such as bacteria, protozoa, and fungus, convert organic molecules in the substrate into advantageous nutrients (Capucille et al., 2002). The physical and chemical properties of the original substrate are altered during composting. Additionally, pathogenic microorganisms (such as bacteria, fungi, and viruses) that could be present in the raw waste are rendered inactive by the heat generated (135° to 150°F) throughout the process (Senne et al., 1994; Lu et al., 2003; USEPA, 2006; Kumar et al., 2007; Bonhotal et al., 2008; Wilkinson et al., 2011; Miller et al., 2016). As a result, an ingredient for animal feed that is comparably sterile, less poisonous, and safe is obtained (Wilkinson et al., 2011). Composted poultry litter has a high concentration of some key minerals that are crucial for animal nutrition, according to chemical research. As far as we are aware, there is no literature on the use of compost in poultry feed. Several studies have reported the use of dead hens and rendered spent hens in poultry feed (Haque et al., 1991; Ochetim, 1993; Olejnik, 1995; Klemesrud et al., 1997; Marks, 1997; Kersey and Waldroup, 1998; Erturk and Celik, 2004; Mutucumarana et al., 2010). It was proposed that composted poultry waste may be added to quail diets up to 10% without adversely affecting their organoleptic properties and compositional profile. Therefore, this study was designed to investigate how the varying levels of dietary compost affected the organoleptic traits and compositional profile of growing Japanese quail.

2. Materials and Methods

2.1. Experimental site, birds, and housing

The Ethical Review Committee of the UVAS approved the experimental animal care practices used in this work, which was carried out at the Avian Research and Training (ART) Centre, UVAS, Lahore. A total of 1200 straight-run newly hatched quail chicks (Coturnix coturnix japonica) were randomly distributed to five treatment groups. Each treatment group contained 40 birds and experiments were replicated six times using a completely randomized design (**CRD**). The experimental meals were otherwise iso-caloric and iso-nitrogenous, but they contained increasing amounts of compost (0, 2.5, 5, 7.5, and 10%). In order to make watering, feeding, and faecal material collection easier, chicks were kept in a well-ventilated octagonal-shaped quail rearing shed outfitted with a five-tiered battery cage system produced in France. Each group of birds was given 91 × 76 × 31 cm galvanized wire cages with an electrical lamp to provide constant lighting. After hatching, the temperature and relative humidity (RH) were 34°C and 62%, respectively, for the first week. Thereafter, the temperature dropped progressively until day 28 when RH was 65% and the temperature was 21°C. On the laterals of the shed, drapes were hung to control the temperature. A tray feeder and two nipple drinkers were provided in each cage for the *ad-libitum* consumption of feed and water, respectively. Tray feeders were replaced with trough feeders and put in the front area of each cage starting at the age of 12 days. Treatment diets (Table 1 and Table 2) were prepared using the analyzed feed ingredient composition and were based on corn-soybean meal to satisfy the nutritional needs of growing meat quails (NRC, 1994).

2.2. Measurements

2.2.1. Sensory evaluation and compositional profile

The three quails per replicate that were closest to the average weight of the same replicate were chosen at 28 days of age and slaughtered in accordance with Halal regulations after undergoing a 4-hour meal fast. Bleeding time was allowed for 3–4 minutes. Then, every carcass was defeathered. Seven experienced panelists from the UVAS, Ravi Campus, Department of Poultry Production participated in the sensory evaluation. The panelists had received training in basic organoleptic assessment procedures in accordance with ISO 3972:2011 (ISO, 2011) using Viriyajare's (1992) methodology. Before being placed individually in a clear polythene bag, samples were first cleaned.

Table 1. Ingredient composition of experimental diets for meat quail.

Ingredient (%)	Treatment[1]				
	T1	T2	T3	T4	T5
Corn	49.00	49.00	46.63	45.33	45.20
Rice tips	6.00	5.00	5.00	5.00	5.00
Canola meal	10.00	6.50	6.40	5.00	0.00
Soybean meal	26.00	27.00	27.00	27.00	30.53
Fish meal	2.00	3.00	3.00	3.00	3.00
Poultry by-product meal	2.00	2.00	2.00	2.00	2.00
Canola oil	2.00	2.00	2.40	2.60	2.30
$CaCO_3$	1.10	0.90	0.50	0.10	0.00
$DCP.2H_2O$	1.10	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.10	0.10	0.10	0.10	0.15
Threonine	0.07	0.07	0.07	0.07	0.07
Sodium chloride	0.25	0.15	0.15	0.00	0.00
Vitamin premix[2]	0.20	0.20	0.20	0.20	0.20
Minerals premix[3]	0.30	0.30	0.30	0.30	0.30
Compost	0.00	2.50	5.00	7.50	10.00

[1]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost. [2]Provided per kg of diet: vitamin A, 11,000 IU; vitamin D_3, 2,160 IU; vitamin E, 44 IU; vitamin K, 4.2 mg; riboflavin, 8.5 mg; niacin, 48.5 mg; thiamine, 3.5 mg; d-pantothenic, 27 mg; choline, 140 mg; vitamin B_{12}, 33 µg. [3]Provided per kg of diet: copper, 8 mg; zinc, 60 mg; manganese, 60 mg; iodine, 0.35 mg; selenium, 0.15 mg.

Table 2. Nutrient composition of experimental diets for meat quail[1].

Nutrient	Treatment[2]				
	T1	T2	T3	T4	T5
Dry Matter (%)	89.15	88.86	89.03	88.62	89.18
Metabolizable Energy (kcal/kg)	2915	2893	2896	2894	2903
Crude Protein (%)	21.8	22.0	22.0	21.9	22.00
Ether Extract (%)	2.92	4.97	5.32	5.49	5.17
Ash (%)	3.76	6.27	6.32	6.15	6.42
Crude Fiber (%)	4.34	4.40	4.77	5.02	5.15
Calcium (%)	0.90	0.99	0.99	1.00	1.10
Phytic Phosphorus (%)	0.66	0.73	0.77	0.80	0.84
Sodium (%)	0.18	0.18	0.21	0.18	0.21
Potassium (%)	0.91	0.95	1.00	1.04	1.11
Lysine (%)	1.27	1.33	1.33	1.30	1.31
Methionine (%)	0.47	0.47	0.47	0.46	0.50
Threonine (%)	0.92	0.90	0.90	0.88	0.87
Cystine (%)	0.40	0.38	0.38	0.37	0.35
Arginine (%)	1.42	1.42	1.42	1.39	1.40
Valine (%)	1.07	1.06	1.05	1.03	1.02
Isoleucine (%)	0.91	0.91	0.91	0.89	0.90
Leucine (%)	1.84	1.83	1.82	1.78	1.79
Histidine (%)	0.58	0.57	0.57	0.55	0.55
Phenyl alanine (%)	1.05	1.05	1.04	1.02	1.04

[1]Diets were formulated on total amino acid basis (TAA). [2]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

After that, they were microwave-cooked in water at 80°C for 45 minutes, let to cool at room temperature, and then given to a group of seven judges. Each panelist was instructed to masticate one sample from each treatment and rate it on a nine-point hedonic scale, with 1 denoting "extremely dislike" and 9 denoting "extremely like," for appearance, color, aroma, taste, texture, juiciness, tenderness, and acceptability. According to the techniques outlined by AOAC (AOAC International, 2005), the raw breast and thigh muscles of fifteen carcasses (three carcasses/treatment) were examined for compositional profiles, including moisture content (by oven drying method), protein (by Kjeldahl method), fat (by Fosslet fat analysis) and ash (by muffle furnace).

2.2.2. Statistical analysis

With the aid of the GLM process of the Statistical Analysis System (SAS Institute Inc., 2003), the data were analyzed under CRD using one-way ANOVA. Using each cage as an experimental unit, treatment means were compared using Duncan's multiple range testing at a probability level of $P<0.05$.

3. Results

Table 3 displays data on organoleptic characteristics. At 28 days of age, there were no significant variations between the treatment diets in terms of appearance, color, aroma, taste, texture, juiciness, tenderness, and acceptability. Similarly, there were no significant differences ($P>0.05$) in the compositional profile values of moisture, protein, fat, and ash content for breast or thigh meats among treatments (Table 4). Although there was a marginally smaller decrease in sensory values in chicks given compost at a 10% level compared to control chicks, this difference was not statistically significant ($P>0.05$).

Table 3. Effect of including compost in the diet on organoleptic properties of meat of Japanese quail[1].

Treatment[2]	Sensory attributes							
	Appearance	Color	Aroma	Taste	Texture	Juiciness	Tenderness	Acceptability
T1	7.11	7.15	7.22	6.96	6.79	6.84	6.63	7.09
T2	7.07	7.09	7.17	6.90	6.71	6.76	6.60	7.01
T3	7.06	7.12	7.12	6.87	6.69	6.74	6.56	6.95
T4	6.98	7.02	6.99	6.81	6.67	6.66	6.47	6.83
T5	6.89	6.95	6.95	6.75	6.78	6.60	6.52	6.79
SEM	0.08	0.09	0.09	0.07	0.07	0.06	0.07	0.08
P-value	0.940	0.964	0.870	0.934	0.984	0.842	0.960	0.815

Treatment means within a column bearing the same letter are not significantly different ($P>0.05$). SEM: standard error of the mean. [1]Data are means ± SEM representing 6 replicates (n=6) with 40 birds per replicate. [2]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Table 4. Effect of including compost in the diet on compositional profile for meat of Japanese quail[1].

Parameter	Treatment[2]						
	T1	T2	T3	T4	T5	SEM	P-value
Breast							
Moisture, %	71.43	69.77	71.28	72.05	70.78	0.79	0.935
Protein, %	20.26	20.16	20.14	20.20	19.98	0.49	0.999
Fat, %	2.61	2.54	2.47	2.53	2.46	0.04	0.834
Ash, %	1.24	1.23	1.23	1.25	1.22	0.01	0.874
Thigh							
Moisture, %	67.16	67.30	68.38	68.43	67.61	1.01	0.993
Protein, %	19.80	19.74	19.61	19.71	19.22	0.41	0.994
Fat, %	3.27	3.25	3.24	3.17	3.10	0.03	0.204
Ash, %	1.32	1.33	1.36	1.38	1.31	0.01	0.552

Treatment means within a row bearing the same letter are not significantly different ($P>0.05$). SEM: standard error of the mean. [1]Data are means ± SEM representing 6 replicates (n=6) with 40 birds per replicate. [2]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

4. Discussion

According to Stone and Sidel (1993), sensory qualities are the aspects of food or a product that a person may perceive through sight, smell, taste, and touch. To assess whether a product is safe to eat, organoleptic tests are carried out (Baracho et al., 2006). Strong sensory qualities that match consumer expectations are required. Color, flavor, and taste are among the sensory qualities that are most closely linked to a product's acceptability (Sanudo et al., 2000; Lyon et al., 2004; Wood et al., 2004), while texture, tenderness, and juiciness are related to the quality of meat for eating (Seabra et al., 2001; Baracho et al., 2006).

The current study's panel of experts found no differences (P>0.05) between the sensory profiles of the meat from quails fed the compost-supplemented diets and those from quails fed the control diet. This suggests that compost can be used in quail rations at levels as high as 10% without affecting the organoleptic quality of the meat. Compost was added to the diet of quail from 0 to 28 days of age, although this had no appreciable impact on the meat's compositional characteristics, including moisture, protein, fat, and ash levels. The same chemical composition or nutritional profiles of the diets may be the cause of the similar compositional profile values for the breast and thigh meats. In consistent with these findings, Williams and Damron (1998a) found that when rendered whole-hen meal was added at a level of 12% to broiler diets, there were no differences (P>0.05) in the sensory characteristics and compositional profiles of the breast and thigh meats. Similarly, Williams and Damron (1998b) concluded that chicken flavor intensity, juiciness, tenderness, or compositional profiles for the breast or thigh meats wouldn't be negatively impacted by adding rendered spent hen meal to broiler diets at a level of 12%.

5. Conclusion

These findings imply that feeding growing meat quails diets containing up to 10% compost is feasible without having any negative impacts on the quail's sensory grading or compositional profile. Additionally, adding compost to quail diets as a feed resource may lower the cost of feed per kg of live weight gain.

Acknowledgements

The management of the ART Centre, Department of Poultry Production, UVAS, and the Punjab Agricultural Research Board (PARB Project No: 582) are sincerely acknowledged by the authors for supporting and facilitating the trial.

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