An Official Journal of Bangladesh Livestock Research Institute (BLRI)
Bangladesh Journal of Livestock Research
Journal Homepage: https://www.banglajol.info/index.php/BJLR
ISSN 1022-3851

Effects of dietary water spinach supplementation on the meat quality attributes of local geese in Bangladesh

MSK Sarker[1, 2*], US Ety[1], MM Rana[4], F Sharmin[3], H Khatun[1], NN Lisa[1], S Faruque[1], SS Zihan[2] and A Islam[1]

[1]Poultry Research Center, Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh.
[2]Strengthening of Poultry Research and Development Project, Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh.
[3]Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207, Bangladesh.
[4]Bangladesh Agricultural Research Council, Farmgate, Dhaka-1215, Bangladesh.

Abstract

Since geese *(Anser anser)* are herbivorous waterfowl, their gizzards are larger and stronger, allowing them to break down high-fiber roughages with greater force and consume enormous volumes of forages. The goal of this study was to evaluate the effectiveness of water spinach *(Ipomoea aquatica)* in identifying the water-holding capacity, meat nutrient composition, pH, drip loss, cooking loss, slaughter and carcass characteristics and meat colour of local Bangladeshi white and grey geese varieties supplemented with varying amounts of water spinach. A semi-intensive production system was used to raise 36 adult geese of both white and grey kinds, which were slaughtered at 28 weeks of age. They were split into four groups at random, each consisting of three replicates with three geese each. Maize soya-based diet was considered as control diet (CL) (2700ME/Kcal, 16% CP) where T_1 & T_3 group were given 180g of CL diets in white and grey variety respectively and other diets included T_2 (White variety)- 80g of water spinach + 140g of CL diet, T_4 (Grey variety)- 80g of water spinach + 140g of CL diet. Following rearing, each bird was weighed separately. Treatments significantly affected the redness value (a*) ($p < 0.05$). A statistical analysis was performed on 12 slaughter traits, which were separated into two groups: measured traits and calculated traits. For slaughter traits, results suggested that beneficial traits were not significantly varied but tented to be higher in the supplemented group. pH value for T_3 group was higher than other groups. Additionally, supplemented group showed lowest drip loss and cooking loss and best water holding capacity, but these parameters were not significantly varied. Notably, the supplemented groups had exhibited the highest dressing percentage, desirable slaughter and carcass traits as well as favourable meat quality parameters. Taking these factors into account, we can say that adding water spinach to geese improved their slaughter and carcass characteristics, meat colour, pH, drip loss, cooking loss, water-holding capacity and meat nutritional content.

Key words: Geese, Water spinach, Carcass traits, Meat quality

Bang. J. Livs. Res. Vol. 30 (1&2), 2023: P. 23-35. https://doi.org/10.3329/bjlr.v29i1.74919

*Corresponding author: sazdulkarim@yahoo.com

Introduction

Alternative chicken species like geese, turkey, quail, and pigeon are becoming popular among consumers due to their natural and organic farming methods. Geese, a traditional grazing animal, are known for their nutrient-dense meat (Schwartz, 2012) and are grass foragers that provide wholesome meat, eggs, and rich fat for cooking. They also help farmers supplement their income and meet their families' needs for animal protein (Hamadani *et al.*, 2017). Additionally, goose meat has a high percentage of polyunsaturated fatty acids (PUFA), low cholesterol (52–76mg/100g) and high-quality protein (Cui *et al.*, 2015). However, because of its exceptional flexibility and roughage utilization, it can eat a lot of forage and agricultural waste. Water spinach, a herbaceous trailing vine, thrives in marshes, freshwater ponds and muddy stream banks and can be considered for supplements due to its availability in our country and nutrient contents of it: DM-12.9, CP-25.9, EE-4.2 and CF-7.3. In order to obtain excellent functional properties processors of value-added meat products must have quantifiable meat qualities like water holding capacity, drip loss, cooking loss, pH, shelf life, protein solubility and fat binding capacity (Mir *et al.*, 2017). Different studies reveal that, geese possess some distinguish characteristics of using roughages, as- Compared to geese supplemented with pasture feeding, meat from non-pasture-fed geese often has fewer nutrients (Liu *et al.*, 2013). Geese fed grass supplemented with grain showed higher Mg and Cu concentrations than geese fed grass alone, according to Song *et al.*'s (2017b) examination of mineral components in goose meat. After substituting forages for a portion of the concentrates, satisfactory BW, dressing % and carcass composition were achieved (Jeroch and Engerer, 1992; Biesiada-Drzazga and Górski, 1997).

However, evaluation of the slaughter traits, carcass nutrient composition in native geese varieties depending on the supplement of water spinach has not performed yet in Bangladesh according to our knowledge. As water spinach is readily available in our country, easy to grow and geese process some distinguish characteristics of utilizing roughages thus the current experiment was designed to explore the slaughter traits, meat quality parameters, carcass nutrient composition in native geese varieties depending on a portion of roughage supplementation.

Materials and Methods

Experimental Layout

The experiment was conducted at the Bangladesh Livestock Research Institute's poultry rearing unit, where 36 adult geese of both White and Grey varieties were kept in a semi-intensive production system for a total of 28 weeks. Goslings were sexed before being placed (1:4 gander to goose ratio). They were split into four groups at random, each consisting of three replicates having three geese each. Maize soya-based diet was considered as control diet (CL diet) (2700ME/Kcal, 16% CP) where T_1 & T_3 group were given 180g of CL diets in white and grey variety and other diets included T_2 (White variety)- 80g of water spinach + 140g of CL diet, T_4 (Grey variety)- 80g of water spinach + 140g of CL diet. All the birds contain individual tag number and each bird was weighed separately at the completion of the rearing stage. Scientific management procedures like- proper vaccination schedule and biosecurity measures are taken there (i.e., Table1). The geese had a natural photoperiod and day length of 11.0 to 12.0 hours during the trial. 65 to 68% humidity was maintained in rearing shed. Continuous lighting was provided throughout the early stage of life, whereas 34^0c, 30^0c and 26^0c brooding temperature was maintained for first week, second week and third week consecutively. There was unlimited access to drinking water throughout the rearing period.

Experimental design:

Replication	Treatments			
	T_1	T_2	T_3	T_4
R_1	3	3	3	3
R_2	3	3	3	3
R_3	3	3	3	3
Sub total	9	9	9	9
Total 36				

T_1=Total concentrate given 180g feed/geese/day (white), T_2= 80g of water spinach+140g feed/geese/day (white), T_3= Total concentrate given 180g feed/geese/day (grey), T_4= 80g of water spinach+140g feed/geese/day (grey).

Table 1: vaccination schedule followed to native geese.

Sl no	Disease name	Name of the vaccine	Age of vaccination	Place of administration	Comments
01	Duck plague	Duck plague vaccine	1st dose at 14-21 days, 15 days after 1st dose, 6 months interval	Intramuscular	Vaccination must be done according to the manufacturer's instructions.
02	Duck cholera	Duck cholera vaccine	1st dose at 28-35 days, 15 days after 1st dose, 6 months interval	subcutaneous	

Biosecurity measures

Maintaining the health and welfare of the animals in poultry farms requires the use of biosecurity measures. Creating and putting into practice daily biosecurity procedures on farms helps to prevent the arrival of harmful microorganisms that could directly affect the production operations. To ensure the health of geese on a farm, we were focusing on preventing disease introduction and spread. This involves limiting access to the farm, maintaining a clean environment, and monitoring for signs of illness. We also took some other measures like- limiting contact with wildlife, regularly cleaning and disinfecting all areas, equipment and vehicles on the farm, quarantining new birds, proper waste management, controlling rodents, insects and other pests etc.

Diets

The birds were raised in uniform surroundings and fed homogeneous diets ranging from 10 to 180 grams each bird until the completion of the rearing period. We formulated the basal diet according to the recommendation of NRC, 1994. Feed ingredients were selected on the basis of availability of the ingredients on that time at the market (i.e., Table 2).

Table 2: Ingredient and nutrient composition of the experimental diets.

Items	Amounts	Nutrient composition	
Ingredients (%)			
Corn	63.0	AME (MJ/kg)	11.25
Soybean meal	28.5	CP(%)	16.1
Fish meal	3.5	Crude fiber (%)	5.2
Soybean oil	2.0	Calcium(%)	1.05
DCP	1.8	Total phosphorus (%)	0.49
limestone	0.2	Salt (%)	0.31
Salt	0.5	Lysine (%)	0.74
Vitamin mineral premix	0.5	Methionine (%)	0.43

Assessment of slaughter characteristics

For identification, birds were wing-tagged with numbered metal bands during the rearing, slaughtering and dressing processes. Birds were weighed after being transferred into the shed and they were weighed once a week. Following rearing, each bird was weighed separately. To ascertain their live weight, carcass and meat quality characteristics, nine of each treatment were culled at 28 weeks of age. Following a 12-hour period of off- fed the birds were slaughtered. In accordance with accepted commercial practices, the birds were then dressed. Before and after plucking, each goose was weighed separately and the feather weight was determined by comparing the two weights. The fat around the abdominal muscles, cloaca and internal organs was measured as abdominal fat. After being cooled for 24 hours at 4°C, the carcasses were divided into pieces using normal techniques. Abdominal fat, leg meat (thigh and drumstick), breast meat (pectoralis major and pectoralis minor) and skin and subcutaneous fat were all taken out of the carcasses and weighed.

Physicochemical parameters

For measuring the pH values a calibrated waterproof pH meter was used. We measure both breast and thigh meat pH at 45 minutes and 24 hours after post-mortem. Three values were obtained by inserting the spear tip probe into the samples from three side faces; the final value was calculated by averaging the three results. Using a standard buffer solution, the pH meter was calibrated. For determining drip loss we followed the method described by Sarker *et al.* (2022). In order to calculate drip loss, which was given as a percentage of the starting muscle weight, we used pectoralis major samples. Within 30 minutes of the fresh meat samples being removed from the muscle, the drip loss was measured. A 13-gram piece of meat was weighed, suspended on a rack at 4°C, then weighed again 24 hours later to determine drip loss.

Drip loss (%) = $[(W_{initial}\text{-}W24\ h)/W_{intial}]\times$ 100%, where W indicates weight (g).

Cooking loss was measured by weighing the pectoralis major samples (W1), vacuum-packing them in a plastic bag, then heating them in a Kjeldahl flask at 75°C until the internal temperature reached 70°C. The bag was then allowed to cool in running water for half an hour. The variance in weight before and after cooking was used to calculate the percentage of cooking loss. Following that, samples of meat were allowed to come to room temperature under running water, dried, and weighed again as

W2. Cooking loss (%) = [(W1-W2)/W1]×100%

A chromameter CR8 (3nh, China) was used to measure the color of the meat in triplicate at various spots on the samples surface. After wiping away any blood or water, the sample was placed vertically in front of the light. Black and white reference tiles were used to calibrate the chromameter. The sample was rotated 120 degrees after the initial measurement to get another value. The third result was then obtained by rotating the sample at the same angle. Following the manufacturer's instructions, the CIE-Lab system values for lightness (L*), redness (a*), and yellowness (b*) were recorded at 45 minutes, respectively.

The a*and b* coordinates were subsequently used to calculate:

Hue angle, h= [tan−1(b*/a*)] and

Saturation index, C= √[(a*)2 + (b*)2].

*T*he compression method was used to determine the WHC of breast flesh. A beef sample weighing about 300+-.1 mg was sandwiched between two pieces of filter paper between two acrylic-plastic plates, and the ultimate weight was determined after exerting 4 kg of force for 20 minutes.

WHC %= 100-(initial wt- final wt)/initial wt*100%.

A number of consumer tests were conducted at the Poultry Research Centre, BLRI, in the case of sensory assessments. A questionnaire were primarily represented by officers and staff. Breast meat which were kept at -20°C and frozen 24 hours after slaughter. The P. major muscle samples were tasted by the assessors after being placed on steel trays covered with aluminum foil and baked for about 25 minutes at 180°C (10% relative humidity) until the interior temperature reached 71.1°C, as determined by a thermometer. Salt and spices were used to cook the breasts. According to Branciari *et al.* (2016), the consumer tests were conducted in two sessions, one week apart. Customers were given the opportunity to practice using a 9-point hedonic scale (ranging from 1, which means "dislike extremely," to 9, which means "like extremely") before to the exam. During the first session, participants were asked to score sensory qualities like juiciness, texture, taste, and overall liking using a 9-point hedonic scale without any knowledge (blind experimental condition). During the subsequent session, the participants evaluated the samples in the informed condition using a 9-point hedonic scale for juiciness, texture, taste, and overall liking.

*D*ry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen-free extract (NFE) and total ash (ASH) were determined by analysing the sample feed ingredients using the AOAC (2000) method. The same technique was used to determine the geese meat's dry matter (DM), crude protein (CP) and ether extract (EE).

Statistical Analyses

The data were statistically analyzed by one-way analysis of variance (ANOVA) through the use of SPSS software (Ver.23.0). Differences among groups were compared using the Duncan's method. The results were presented as means with their pooled standard errors (SEM). Differences between groups were considered significant when the p value was <0.05.

The mathematic model was:

$Y_{ik}= \mu + T_i + \varepsilon ik$ where, Y_{ijk} is the observed response of bird in a pen, μ the overall mean; T_i is the fixed effect of the treatment; εik is the residual error when the pen was regarded as an experimental unit.

Results & Discussion

Meat quality parameters such as water holding capacity, drip loss, cooking loss, pH and self-life etc are important parameters for both raw meat buyer and value added meat producer, but these parameters are affected by breed, variety, selection level, gender, age, nutrition, production system and fattening period (Fortin *et al.*, 1983; Tilki and Inal, 2004; Shi et al., 2010; Liu *et al.*, 2011). Sometimes it also affected by environmental conditions at slaughter, production season, stocking density and their interconnections may also impact these characteristics (Castellini *et al.*, 2002; Karacay *et al.*, 2008). In our study we found how water spinach supplements affected those parameters.

Color of goose meat

Colour affects consumers' decisions to buy meat products because they associate meat colour with freshness (Sarica and Yamak, 2015). Pigments regulate the colour of meat's surface. Total pigment concentration has a negative association with the L* value and a positive correlation with the Fe and a* values. The L* parameter signifies the lightness of the color and it is located on a vertical axis in space and its value ranges from 0 (black) to 100 (white). The coordinates a* and b* represents the values from which saturation and hue of color was calculated. The value of 00 for + a* represents red, 900 for +b* yellow. 1800 for - a* represents green, 2700 for -b* blue. The redness value and breast meat colour values (a*) varied significantly when water spinach was added (Table 3). Those values for geese meat are almost similar to Kuzniacka *et al.* (2020). The concentrated geese had a higher breast meat lightness (L*), while the supplemented group had a lower lightness. Redness (a*) and yellowness (b*) were considerably higher in the supplemented T_2 and T_4 group. (p=0.003) respectively. Saturation index value implies how vivid the color is and hue angle implies the exact color value. In our study saturation index value was higher for this T_2 group and the hue angle (43.27) was higher for the non-supplemented group. According to Chen *et al.* (2022) Supplementation with ramie powder at a certain percentage also improved the muscle flesh color and water retention of Yanling white geese which, in turn, improved the quality of the meat. In comparison to our current investigation Sarica *et al.* (2014) found lower meat colour results for both geese types. Nutrition, age, environmental factors and other management practices may be the cause of variations in meat colour values between this study and those that have been previously published. For instance, Hughes *et al.* (2014) found that the colour and pH of meat can be influenced by age, the production method and nutrition.

Slaughter traits of goose meat

Since lean meat is seen to be the most important portion of the carcass, poultry producers endeavor to increase the rate at which muscle tissue grows. According to Lilja (1981), very young goslings and ducklings have well-developed leg muscles but underdeveloped breast muscles and geese's leg muscle weight starts to decline at two weeks of age, whereas their breast muscle weight quickly rises until ten weeks. An animal's nutritional intake from the meal can be accurately determined by looking at carcass characteristics. The quality of the

Table 3: The meat colour parameter of native geese with regard to different proportions of water spinach.

Traits	Treatments				SEM	p-value
	T_1	T_2	T_3	T_4		
L*	42.73	37.73	42.88	38.46	2.62	0.110
a*	8.90^c	14.32^a	10.10^b	12.68^{ab}	0.934	0.003
b*	8.60	8.97	8.76	8.18	1.473	0.942
Hue angle	43.27	32.08	39.37	32.97	4.613	0.093
Saturation index	12.59	16.92	13.44	15.12	1.41	0.065

L*- Lightness, a*- Redness, b*- Yellowness, Values of different variables under different treatment indicate Mean; SEM= standard error of means; $^{a-c}$Means with different superscript differ significantly (p<.05). T_1=Total concentrate given 180g feed/geese/day (white), T_2= 80g of water spinach+140g feed/geese/day (white), T_3= Total concentrate given 180g feed/geese/day (grey), T_4= 80g of water spinach+140g feed/geese/day (grey).

breast muscle is one of these traits that most significantly determine the production performance. The analysis of slaughter traits of 28 weeks age old geese did not show significant differences between groups, p>0.05. Table 4 showed that, the highest pre-slaughter weight (on an average 3997.33) was obtained by T_2 group. The carcass weight as well as the weight of muscle is the most valuable components. On which in case of carcass weight, T_1 and T_2 yielded 1778gm and 1866gm. In case of muscle weight supplemented T_2 group yielded about 839gm which is higher than other groups. Most favourable dressing percentage was characterized by T_4 group, on an average it was 48.43%, another calculated trait was meatiness which showed more carcass muscle % and This parameter showed higher value for T_2 (on an average 44.96%). Both values were higher in treatment group but not significantly varied. Aslan *et al.* (2022) demonstrated that the inclusion of corn silage in geese diets did not significantly impact their dressing percentage which is similar to our study. The abdominal fat on an average 4.82% and 5.32% and the skin with subcutaneous fat is about 37.30% and 30.44 % in case of T_2 and T_4 group, which is desirable in treatment group. Other traits were not significantly varied. Our findings is also associated with kokoszynski *et al.* (2014). They found that dilution of the diet for young fattening geese with whole-crop silage had a positive effect on production economics and carcass composition. Another study reveal that, replacing commercial feed with whole-plant silage maize in the diet of Holdobaki geese has significant effects on their growth performance, carcase yield, relative organ weight, and blood biochemical parameters (Wang *et al.*, 2023)

pH, drip loss, cooking loss and water holding capacity of goose meat

In this experiment, all the group exhibited similar pH values within the normal range. According to Song *et al.* (2017)'s findings on different feeding regimes did not change the pH values of goose meat similar to our study. The results showed that, pH was higher in T_3 group but not significantly varied. Drip loss and cooking loss another indicator for meat quality traits, that did not differ significantly (p=0.553 & p=0.738). The treatment group showed lowest drip loss and cooking loss. Water holding

Table 4: The measured and calculated traits of the native geese with regard to supplementation of different proportion of water spinach.

Traits	Treatments				SEM	p-value
	T_1	T_2	T_3	T_4		
Pre-slaughter wt (g)	3923.33	3997.33	3517.67	3304.00	122.20	0.200
Carcass wt (g)	1778.00	1866.67	1578.33	1600.33	48.15	0.915
Dressing%	45.20	46.73	45.19	48.43	1.83	0.260
Breast wt (g)	371.00	378.33	279.33	344.67	31.91	0.288
Thigh wt (g)	220.00	218.00	201.67	168.00	13.73	0.230
Drumstick wt (g)	229.33	242.67	212.00	191.33	12.179	0.771
Abdominal fat	137.67	88.67	147.67	86.00	32.93	0.131
Skin with sub fat	704.33	696.33	608.00	491.67	62.97	0.352
(Total muscles)	820.33	839.00	693.00	704.00	39.22	0.715
Meatiness %	43.67	44.96	43.90	43.87	1.71	0.720
Abdominal fat%	7.32	4.82	9.42	5.32	2.07	0.151
Skin%	37.51	37.30	38.34	30.44	3.60	0.292

Total muscles= Breast+thigh+ drum. Wt- weight, g- gram. Values of different variables under different treatment indicate Mean; SEM= standard error of means; a-cMeans with different superscript differ significantly ($p<.05$). T_1=Total concentrate given 180g feed/geese/day (white), T_2= 80g of water spinach+140g feed/geese/day (white), T_3= Total concentrate given 180g feed/geese/day (grey), T_4= 80g of water spinach+140g feed/geese/day (grey).

capacity does not affect significantly but tented to be higher in T_4 group. For assessing the quality of characteristics such water holding capacity, cooking loss, texture, colour and shelf life, the meat's pH value is a useful metric (Berri, 2004). Increased catecholamine secretion in response to an acute stressor shortly before slaughter speeds up the breakdown of glycogen and the rate at which pH decreases after slaughter while the carcass temperature is still high, producing pale, soft, exudative meat. Bacterial growth is inhibited when the pH of meat drops. Accordingly, meats with a high pH have a lower shelf life because of microbial development. But high pH prevents intramuscular protein decomposition, meat appears stiffer and more unappealing (dry, firm and darker colour) (Sarica *et al.*, 2014). According to our research, the pH of meat was greater than 5.7, this could have been caused by the slaughter process and related to stress. As our result showed that, treatment group had lower drip loss and cooking loss, it is desirable for further technological processing and has a significant impact on the texture of meat. Muscles with a reduced WHC may have liquid outflow, which would eliminate flavour and soluble nutrients. This lowers the quality of the meat and causes the muscle to become dry, hard and tasteless. In case of our study best WHC found in the treated groups. Similar results also found Kuzniacka *et al.* (2020), which revealed that the use of narrow-leaved lupin had no negative effect on the meat traits. Liu and Zhou, (2013) demonstrated that, Pasture intake did not enhance growth performance but improved carcass characteristics and meat quality traits of geese. Physical activity and meat pH, which has been demonstrated to impact meat quality attributes- like WHC, CL, texture, colour and shelf-life, may be

Table 5: The meat pH, drip loss, cooking loss of the native geese with regard to supplementation of water spinach.

Traits	Treatments				SEM	p-value
	T_1	T_2	T_3	T_4		
pH	5.75	5.84	5.87	5.76	0.074	0.913
Drip loss	4.94	4.91	4.56	4.11	1.28	0.553
Cooking loss	27.47	28.14	25.94	26.48	1.754	0.738
WHC	39.89	41.14	41.35	41.63	0.473	0.142

WHC= water holding capacity. Values of different variables under different treatment indicate Mean; SEM= standard error of means; $^{a-c}$Means with different superscript differ significantly (p<.05). T_1=Total concentrate given 180g feed/geese/day (white), T_2= 80g of water spinach+140g feed/geese/day (white), T_3= Total concentrate given 180g feed/geese/day (grey), T_4= 80g of water spinach+140g feed/geese/day (grey).

Table 6: Effects of water spinach on chemical analysis of geese meat at adult stage.

Traits	Treatments				SEM	p-value
	T_1	T_2	T_3	T_4		
DM	31.70	32.10	30.73	30.97	0.618	0.622
CP	23.70	24.13	23.97	23.70	0.253	0.204
EE	4.70	4.80	4.80	4.33	0.159	0.282

Values of different variables under different treatment indicate Mean; SEM= standard error of means; $^{a-c}$Means with different superscript differ significantly (p<.05). T_1=Total concentrate given 180g feed/geese/day (white), T_2= 80g of water spinach+140g feed/geese/day (white), T_3= Total concentrate given 180g feed/geese/day (grey), T_4= 80g of water spinach+140g feed/geese/day (grey).

linked to higher CL and DL and lower WHC (Berri, 2004).

Proximate Component adult geese meat

While T_2 had a greater crude protein content (24.13), we noticed that T_3 groups had higher fat contents (4.80). our findings is similar to Song et al. (2017b). According to Liu *et al.* (2022) the use of alfalfa-mixed silage may increase the amount of muscle protein and lower the amount of crude fat in geese meat. That study showed that, protein, collagen, Mg and Cu content were greater to a degree, in geese reared under a grazing condition when a grain supplemental diet is provided. The DM content of the various treatment groups did not differ significantly (0.662). As muscle nutrient composition determines meat's nutritional value (Biesiada-Drzazga, 2011). According to Sarica *et al.* (2014), females had larger levels of fat and dry matter in their breast flesh. Our research also yielded similar findings. Protein and fat content values were comparable to the current study in another investigation on local geese raised in intensive and free-range production systems, however the dry matter of this study was found to be greater Boz *et al.* (2017). According to Mao *et al.* (2019) supplementation of CF in goose diets influenced the meat quality. Since the production system, age, and protein-energy levels of feed all had an impact on meat parameters, differences were assumed to be caused by age, breeding system, and nutrition (Kannan *et al.*, 2006; Boz *et al.*, 2017).

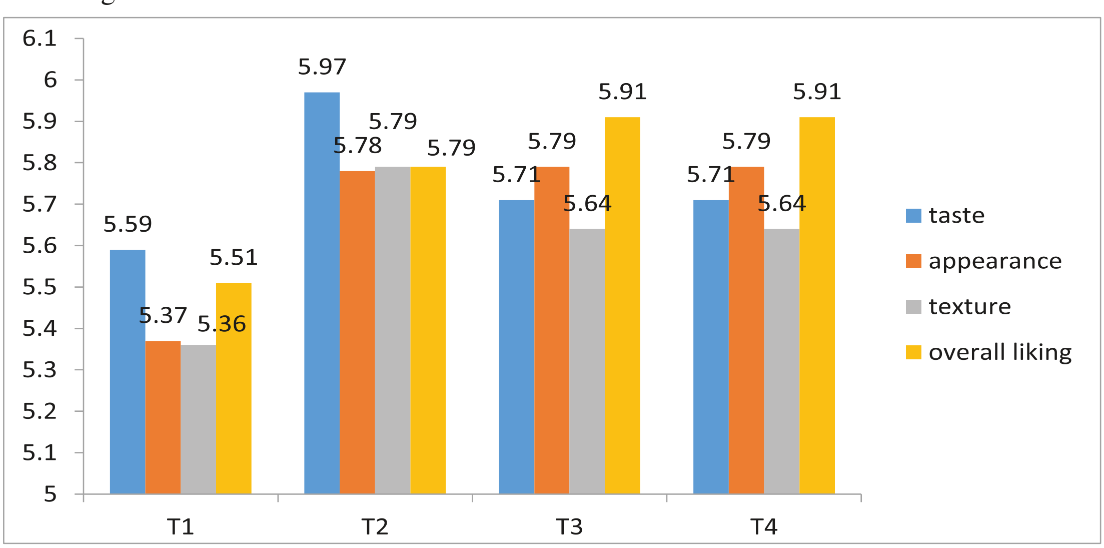
Sensory Analyses of meat (blind liking scores) for supplementation of water spinach on adult geese

Consumers initially assess meat based on its appearance (colour, fattiness) and aroma (Adamski *et al.*, 2016). Before and after buying a meat product, consumers' initial and ultimate quality judgements are influenced by the most significant and noticeable aspects of the meat: appearance, texture, juiciness, firmness, tenderness, odour and flavour. In one part of our country people prefer adult geese over goslings because they believe the latter to be less tasty. On other parts in order to achieve what is thought to be the ideal body weight and meat performance, meat geese are often slaughtered and sold between the ages of 4 and 5 months. Feeding Yangzhou geese with paper mulberry silage is feasible, which can improve the sensory quality and nutritional value of goose meat Wang *et al.* (2024). In case of our study we consider adult geese and it is associated with it. Figure 01 presents the findings of consumer testing conducted for geese meat under blind settings. In the blind exam, the four groups scored nearly identically. According to the results of our investigation, geese meat received a 64% score for each characteristic. People take it rather nicely.

Conclusion

As herbivorous birds, geese can effectively consume and digest green feed. Their grazing demands can be satisfied and their consumption of dietary fibre increased by adding water spinach to their diet. This improves their health and well-being and lowers their risk of diseases and undesirable behaviours. Notably, the supplemented groups had exhibited the highest dressing percentage, desirable slaughter and carcass traits as well as favourable meat quality parameters. As geese can efficiently use

Table 7: Sensory Analyses of meat (blind liking scores) for supplementation of water spinach on adult geese.



T_1=Total concentrate given 180g feed/geese/day (white), T_2= 80g of water spinach+140g feed/geese/day (white), T_3= Total concentrate given 180g feed/geese/day (grey), T_4= 80g of water spinach+140g feed/geese/day (grey).

fibrous feed, so that roughages can partially replace their concentrates. Considering the above findings, it may conclude that supplementation of geese with water spinach found to be beneficial for improving meat quality parameters of geese.

Conflict of interest

The Authors declare that there is no conflict of interest in related to this paper.

References

Adamski, M., Kucharska-Gaca, J., Kuzniacka, J., Kowalska, E., Czarnecki. R. 2016. Effect of selected factors on slaughter yield and quality of goose meat. Technologia. Jakosc., 5: 33–44.

AOAC. 2000. Official Methods of Analysis. 17th ed. Association of Official Analytical Chemist. Arlington, Virginia.

Aslan, R., Ozturk. E. 2022. Effects of Maize Silage Feeding on Growth Performance, Carcass Characteristics, Digestive System Weight, Chemical Composition and Meat Quality of Domestic Geese. Trop Anim Health Prod., 28; 54(5):325. doi: 10.1007/s11250-022-03313-5.

Berri, C. 2004. Breeding and quality of poultry, in: Mead, G.C. (Eds) Poultry meat processing and quality, 21–23 (Cambridge, CRC Press).

Biesiada-Drzazga, B., and Górski.J. 1997. The effect of feeding on carcass composition of geese during raising and fattening period. Zesz. Nauk. Prz. Hod., 32: 205–215.

Biesiada-Drzazga, B., Janocha, A., Koncerewicz. A. 2011. Effect of genotype and rearing system on fatness and fat quality in geese of White Koluda breed. Post. Nauk. i Technol. Prze. Rol.-Spoz., 66:19–31.

Boz, M. A., Sar, M., Yamak, U.S. 2017. Production traits of artificially and naturally hatched geese in intensive and free-range systems – II: slaughter, carcass and meat quality traits. Brit. Poult. Sci., 58:166–176.

Branciari, R., Balzano, M., Pacetti, D., Trabalza-Marinucci, M., Della Casa, G., Miraglia, D., and Ranucci, D. 2016. Dietary CLA supplementation of pigs confers higher oxidative stability to Ciauscolo and Fabriano salami produced from their meat with no negative impact on the physico-chemical, microbiological and sensorial characteristics. Eur. J. Lipid Sci. Technol., 118: 1475– 1485.

Castellini, C., Mugnai, C., Dal Bosco, A. 2002. Effect of organic production system on broiler carcass and meat quality. Meat Science., 60: 219–225. doi:10.1016/S0309-1740(01)00124-3.

Chen, F., He, J., Wang, X., Lv, T., Liu, C., Liao, L., Li, Z., Zhou, J., He, B., Qiu, H., and Lin.Q. 2022. Effect of Dietary Ramie Powder at Various Levels on the Growth Performance, Meat Quality, Serum Biochemical Indices and Antioxidative Capacity of Yanling White Geese. Animals., 12: 2045. https://doi.org/10.3390/ ani12162045.

Cui, L. L., Wang, J. F., Xie, K. Z., Li, A. H., Geng, T.Y., Sun,L,R., Liu, J.Y., Zhao, M., Zhang, G.X., Dai,G.J., 2015. Analysis of meat flavor compounds in pedigree and two-strain Yangzhou geese. Poult. Sci., 94.,2266–2271.

Fortin, A., Grunder, A. A., Chambers, J. R., Hamilton, R. M. G. 1983. Live and carcass characteristics of four strains of male and female geese slaughtered at 173, 180, and 194 days of age. Poult. Sci., 62: 1217–1223. doi:10.3382/ps.0621217.

Hamadani, H., Khan, A. A., Salahudin, M., Sofi, A. H., Banday, M.T. 2013. Slaughter and carcass characteristics, sensory attributes and consumer acceptability of geese meat. Indian. J. Poult. Sci., 48:223-7.

Hughes, J. M., Kearney, G., Warner, R. D.2014. Improving beef meat colour scores at carcass grading. Anim. Prod. Sci., 54:422– 429.

Jeroch, H., and Engerer. K. H. 1992. Corn-Cob Mix (CCM) for table geese feeding. Proc. 9th Eur. Symp. on Waterfowl. World's Poultry Science Association, Pisa, Italy.

Kannan, G., Gadiyaram, K. M., Galipalli, S., Carmichael, A., Kouakou, B., Pringle, T. D., Mcmillin, K.W., Gelaye, S. 2006. Meat quality in goats as influenced by dietary protein and energy levels, and postmortem aging. Small Rumin. Res., 61.45–52.

Karacay, N., Ocak, N., Sarica, M., Erener. G. 2008. Effect of carbohydrate supplementation provided through drinking water during feed withdrawal on meat and liver colours in broilers. Journal of the Science of Food and Agriculture., 88: 479–484. doi:10.1002/(ISSN)1097-0010.

Kokoszynski, D., Bernacki, Z., Grabowicz, M., Stanczak. K. 2014. Effect of corn silage and quantitative feed restriction on growth performance, body measurements, and carcass tissue composition in White Koluda W31 geese. Poultry Science., 93: 1993–1999. http://dx.doi.org/10.3382/ps.2013-03833.

Kuzniacka, J., Hejdysz, M., Banaszak, M., Jakub, B., Kaczmarek, S., Grabowicz, M., Rutkowski, A., and Adamski, M. 2020. Quality and physicochemical traits of carcasses and meat from geese fed with lupin-rich feed. Animals., 10,519. Doi: 10.3390/ani10030519.

Li, H., Liu, Y., Wei, L., Lin, Q., Zhang, Z.F. 2022. Effects of Feeding Fermented Medicago sativa (Plus Soybean and DDGS) on Growth Performance, Blood Profiles, Gut Health, and Carcass Characteristics of Lande (Meat) Geese. Front. Physiol., 13: 902802.

Li,M., Zi, X., Tang, J., Tieshan Xu, T., Gu, L., and Zhou .H. 2019.Effects of cassava foliage on feed digestion, meat quality, and antioxidative status of geese. Poultry Science., 0:1–7. http://dx.doi.org/10.3382/ps/pez522.

Lilja, C. 1981. Postnatal growth and organ development in the goose (Anser anser). Growth., 45:329–341.

Liu, B.Y., Wang, Z.Y., Yang, H. M., Wang, J. M., Xu, D., Zhang, R., Wang, Q. 2011. Influence of rearing system on growth performance, carcass traits, and meat quality of Yangzhou geese. Poultry Science., 90: 653–659. doi:10.3382/ps.2009-00591.

Liu, D. C., Zhou, X.L., Zhao, P.T., Gao, M., Han, H.Q., and HongLian. H.U. 2013. Effects of increasing non-fiber carbohydrate to neutral detergent fiber ratio on rumen fermentation and microbiota in goats. J. Integr. Agric., 12:319–326.

Liu, H.W., and Zhou, D.W. 2013. Influence of pasture intake on meat quality, lipid oxidation, and fatty acid composition of geese. J. Anim. Sci., 91:764–771. doi:10.2527/jas2012-5854.

Mir, N.A., Rafiq, A., Kumar, F., Singh, V., Shukla.V. 2017. Determinants of broiler chicken meat quality and factors affecting them: a review. Journal of food science and technology., 54(10): 2997–3009. https://doi.org/10.1007/s13197-017-2789-z

Sarica, M., Boz, M. A., and Yamak. U. S. 2015. Yozgat ili halk elinde yetistirilen beyaz ve alaca kazlarin kesim ve karkas ozellikleri. Turkish JAF Sci. Tech., 3:142–147.

Sarica, M., Boz, M.A., and Yamak, U. S. 2014. Meat quality traits and some blood parameters of white and multicolor geese reared in backyard in Yozgat. Anadolu J. Agr. Sci., 29:147–153.

Sarker M.A.H., Hossain M.E., Habib M., Hashem M.A and Ali M.S. 2022. Comparison of meat yield and physicochemical characteristics of indigenous, cockerel and sonali chicken, Meat Research., 2022: Vol 2, Issue 6, Article 39 ISSN: 2790-1971. https://doi.org/10.55002/mr.2.6.39.s

Schwartz, S. 2012. A metagenomic study of diet-dependent interaction between gut microbiota and host in infants reveals differences in immune response. Genome Biol., 13:32.

Shi, S.R., Wang, Z. Y., Zou, J. M., and Jiang, N. 2010. Effects of dietary threonine on growth performance and carcass traits of Yangzhou geese. Czech Journal of Animal Science., 55: 382–387.

Song, Y., Li, Y., Zheng, S., Dai, W., Shen, X., Zhang, Y., Zhao, W., Chang, G., Xu, Q., Chen. G. 2017b. Effects of forage feeding versus grain feeding on the growth performance and meat quality of Yangzhou geese. Br. Poult. Sci., 58: 397-401.

Tilki, M., and Inal. S. 2004. Yield traits of geese of different origins reared in Turkey III. Slaughter and carcass traits. Turkish Journal of Veterinary and Animal Science., 28: 165–17.

Wang, R., Wang, X., Xiong, Y., Cao, J., Nussio, L.G., Ni, K., Lin,Y., Wang, X., Yang. F. 2024.Dietary Paper Mulberry Silage Supplementation Improves the Growth Performance, Carcass Characteristics, and Meat Quality of Yangzhou Goose. Animals., 14: 359. https://doi.org/10.3390/ani14030359.

Wang, X., Li, G., Liu, Y.,Yang, Y.,Wang, C., Gong, S., Zhu, L., Lei, H., Huiying Wang, H.,and He .D. 2023. The effects of whole-plant silage maize as replacement commercial feed on the growth performance, carcase yield, relatively organ weight, blood biochemical, and economical traits in Holdobaki Goose. Cogent Food & Agriculture., 9: 2236825. https://doi.org/10.1080/23311932.2023.2236825.