Journal of Food Science and Technology (Iran)

Homepage:www.fsct.modares.ir

Scientific Research

Investigation into the Partial Replacement of Broiler Chickens Corn Diet with Potato Waste on the Some Physicochemical Characteristics of Breast Meat

Younes Zahedi [1]*, Arezoo Nosrati-Aminjan[2], Mir Daryoush Shakouri[3], Sorena Vahedipour-Dahraie[2]

1–Associate professor, Department of Food Science & Technology, Faculty of Agriculture and Natural Resources, University of Mohaghegh Ardabili, Ardabil, Iran

2 –MSc graduated in Food Technology, Department of Food Science & Technology, Faculty of Agriculture and Natural Resources, University of Mohaghegh Ardabili, Ardabil, Iran

3 –Associate professor, Department of Animal Science, Faculty of Agriculture and Natural Resources, University of Mohaghegh Ardabili, Ardabil, Iran

ARTICLE INFO

Article History:

Received: 2025/09/28

Review: 2026/04/22

Accepted: 2026/05/20

Keywords:

Broiler chicken,

Meat quality,

Potato waste,

Ration modification

DOI: **10.48311/fsct.2026.116662.1004**

*Corresponding Author E-

younes.zahedi@gmail.com

Y_zahedi@uma.ac.ir

ABSTRACT

The aim of this research was to investigate the effects of replacing some corn of broiler ration with potato waste (PW)(cull potato) on some physic-chemical characteristics of chicken breast. The research was conducted in the form of a completely randomized design with 5 treatments and 16 chicken pieces in 4 replications. The experimental treatments were as follows: 1) control, 2) containing 25% of raw PW, 3) containing 25% of heated PW, 4) containing 50% of heated PW, 5) containing 50% of raw PW. After 42 days of rearing the chickens, slaughter was done and the breast was selected for evaluations. The results showed that ultimate pH of treatments 3 and 4 notably increased ($p<0.05$). A significant decrease of drip loss was observed during storage ($p<0.05$). Water holding capacity was influenced by treatment and time of storage ($p<0.05$). Expressed moisture (EM) and the drip area (B/A ratio) values of meat from treatments containing potato waste were lower than control. The mean values of EM for T2 and T3 were 9.8%, and for T4 and T5 were 8.8%, that was smaller than control (13.1%). Using PW in the chicken ration didn't change cooking loss of the obtained meats ($p>0.05$). The use of PW, due to its antioxidant compounds, slowed down fat oxidation and decreased the TBA index in the meat of treated chickens ($p<0.05$). In conclusion, partial replacement of PW in the broilers diet improved WHC and decreased TBA of breast muscle, and therefore, PW has the potential to be use in the diet of broilers.

1- INTRODUCTION

Chicken meat is an essential source of protein in various countries, including Iran. Among the reasons that make chicken meat particularly important are its higher protein content than other meats, lower carcass loss after slaughter compared to cattle and sheep, limited zoonotic diseases, easier digestion, lower cholesterol, and higher growth rate. In terms of energy, chicken meat has 165 kcal per 100 g, lower than mutton (180 kcal per 100 g), so it can be recommended for those who are looking for low-calorie diets [1, 2, 3, 4]. Potato is one of the most important and widely used food product in the world following rice, wheat, and corn. Annual potato production in Iran is about 5 million tons which about 35% is wasted during handling and processing, the waste if not used, leads to environmental issues [5]. In poultry production, feed accounts for more than 70% of total costs and considerably affects profitability. Corn, as the main source of energy in broiler diets, is often included 50–70%, and its high cost has made it as a major concern for producers. This situation has led to ongoing efforts to identify alternative feed ingredients that are cost-effective and nutritionally adequate. One way to reduce the cost of feeding livestock and poultry is to use the agricultural waste from food processing factories [6, 7]. Nowadays, the use of food wastes such as soybeans, sugarcane and sugar beet molasses, cottonseed meal, wheat straw, and especially potato in the diet of broilers has received more attention than ever before. Potato is an affordable energy resource equivalent to corn. Raw potatoes have high nutritional value because of high starch content and nutrient digestibility as well as their palatability. Various studies in recent years have shown that the application of cull potatoes has a positive effect on the growth characteristics and carcass performance of broilers [7, 8]. Studies on fattening animals show that the processing of potato waste by cooking and other processing methods and adding to the diet of ruminants has beneficial effects on growth performance and apparent digestibility of nutrients. Also, potato waste from the food industry, the potatoes removed during sorting, and unusable fried potatoes are appropriate alternative to barley grain in the diet [9].

Water holding capacity (WHC) is one of the most important functional and quality properties of meat and a principal characteristic for both producers and consumers. WHC refers to the ability of meat to retain water during operations such as cutting, heating, grinding or pressing, and centrifugation. If WHC of the tissue is to be low, moisture loss and weight loss during storage increase. High WHC causes to increase of stability, juiciness, and apparent firmness of the meat, leading to improved quality and economic value [10]. Among the studies conducted in the field of replacing or modifying livestock and poultry diets, the following can be mentioned; The results of the study by Abdel-Daim et al. [11] showed that feeding broilers with potato peel and sugar beet pulp (with and without enzyme supplementation) did not affect the physicochemical and sensory properties of chicken breasts and thighs; Adding enzyme to the diet led to increase in crude protein and a decrease in meat ether extract, as well as augmentation of WHC and a decrease in the cooking loss. The results of Al-Harthi and Attia [12] indicated that the employment of 10 and 20% olive pomace with and without the addition of citric acid in the diet of 28- to 49-day-old broilers had no negative effect on pH, color, WHC, and meat texture.
Considering the above points, the aim of the present study was to use different levels of potato waste with and without heat treatment in the diet of broiler chickens and to investigate the effects of its consumption on some physicochemical properties (pH, WHC, expressed moisture, cooking loss, and thiobarbituric acid) during refrigerated storage.

2-Material and methods

Potato waste was prepared from Leman potato processing factory (Ardabil, Iran). After disinfecting the environment, the waste was dried in the shade, ground by a hammer mill to produce powder with the size of 2-4 mm (Starter: 2 mm, grower: 3 mm, and Finisher: 4 mm) using a hammer mill with a capacity of 500 kg/h and mixed according to the diet composition for use in broiler diets.

This study was conducted in a completely randomized design with 5 treatments and 16 chicks (per pen) in 4 replications. Chicks were fed a diet based on corn and soybean meal during the rearing period and according to the recommendations of Ross Company. The temperature of the house was 29 °C on the first day according to the Ross 308 strain breeding guide, which was reduced by 1 °C every 3 days until it was finally in the temperature range of 20-21 °C at the end of the third week and then its value was constant until the end of the experimental period. The light program was applied as 24-hour lighting at the beginning of the period and then 16 h of light and 8 h of darkness. Vaccination of chicks was carried out according to the regional conditions and the program recommended by the Veterinary Organization of Ardabil Province. For better consumption of drinking vaccines, the drinking water of the chicks was cut off about 2 h before vaccination and then the vaccines were provided to the chicks as water-soluble vaccines. The experimental diets contained two groups of heated potatoes (100 °C for 45 min by oven) and unheated (raw) potatoes at levels of 25% and 50% of corn replacement in the diet and were as follows. Table 1 presents some of the chemical compositions and raw energy of potato waste used in this experiment and Table 2 presents the composition of the corn and soybean meal-based diets. The experimental diets used in this study were not isocaloric and isonitrogenous:

1) Control diet based on corn-soybean meal, 2) diet containing 25% raw potato waste as a corn substitute, 3) diet containing 25% heated potato waste as a corn substitute, 4) diet containing 50% heated potato waste as a corn substitute, and 5) diet containing 50% raw potato waste as a corn substitute.

After 42 days of rearing, the chickens were slaughtered and after skinning and evisceration, the breast meat (fillets) was selected and separated for further experiments. The fillets were washed with tap water and after complete dehydration, they were packed in zip-packs and transferred to the laboratory refrigerator (4 °C.)

Table 1: Chemical composition of dried potato waste

Dry matter (%)	Ash (%)	Fat (%)	Protein (%)	Crude energy (Kcal/Kg)
89.12±3.26	8.11±1.09	1.22±0.14	13.34±1.37	3375.52±34.26

Table 2: Ingredients and compositions of the basal diets.

Ingredients (%)	Starter (1-10)	Grower (11-24)	Finisher (25-42)
Maize	46.61	52.07	54.01
Soybean meal	43.29	38.21	35.40
Vegetable oil	5.26	5.37	6.49
Dicalcium phosphate	1.93	1.77	1.65
Oyster shell	1.31	1.10	1.06

Common salt	0.41	0.41	0.41
Mineral premix 1	0.25	0.25	0.25
Vitamin premix 2	0.25	0.25	0.25
DL-Methionine	0.36	0.28	0.23
L-Lysine HCl	0.29	0.26	0.20
Total	100	100	100
Composition (calculated)			
Metabolizable energy (kcal/kg)	3025	3100	3200
Crude protein (%)	23.50	21.65	20.50
Lysine (%)	1.52	1.37	0.25
Methionine (%)	0.71	0.61	0.54
Methionine + Cysteine (%)	1.08	0.96	0.88
Arginine (%)	1.53	1.39	1.31
Calcium (%)	1.08	0.95	0.90
Available phosphorous (%)	0.51	0.47	0.44
Sodium (%)	0.18	0.18	0.18

1. Provided per kg of diet: Vit A: 9000 IU, Vit D3: 2000 IU, Vit E: 36 mg, Vit K3: 2 mg, Vit B1: 1.75 mg, Vit B2: 6.6 mg, Calcium pantothenate: 9.8 mg, Niacin: 10 mg, Vit B6: 2.94 mg, Vit B9: 1 mg, Vit B12: 0.015 mg, Choline chloride: 250 mg, Antioxidant: 1 mg.
2. Provided per kg of diet: Mn: 99.2 mg, Zn: 84.7 mg, Fe: 50 mg, Cu: 10 mg, I2: 0.99 mg, Se: 0.2 mg.

pH

The pH was measured by a probe pH meter (Testo 205, Germany) on the fillet at two points at a depth of 1- 1.5 cm at 24 h after slaughter. Before starting the measurement, the meat samples were removed from the refrigerator to reach ambient temperature.

Drip loss

To determine the drip loss of meat on days 2, 4 and 6 after slaughter, Honikel method [13] was used. About 40 g of meat with a thickness of 2 to 2.5 cm was placed in a plastic net and the net containing the meat was hung inside a cylindrical container with a lid; the container was closed and kept in the refrigerator until the measurements were made at the mentioned times. Drip loss was calculated using equation 1, where m_1 is the weight of meat on the day before measurement and m_2 is the weight of meat on the day of measurement:

$$\text{Drip loss (\%)} = \frac{m_1 - m_2}{m_1} \times 100 \quad [1]$$

Water holding capacity (WHC)

To determine WHC, two procedures were used: weighing (estimating the expressed moisture) and measuring the moisture area (leaching); expressed moisture was measured on days 2, 5, and 7. 0.3 g of ground meat was weighed using an electric grinder (FUMA 491, Japan) and placed on Whatman filter paper No. 1 (9 cm Qualitative, GE Healthcare, UK). Then, the filter paper was transferred onto a plastic sheet and another sheet was placed on the meat sample. A 2-kg weight was placed in the center of the sheet and exactly on the sample for 5 min. After this time, the weight was removed and the meat sample was completely separated from the filter paper and the paper was weighed. The percentage of expressed moisture was calculated from equation 2, where W_s is the weight of ground meat, W_1 is the initial weight of the filter paper, and W_2 is the weight of the filter paper after separating the meat from it. Following weighting, the area of the expressed fluid on the each filter paper was scanned by a scanner (Canon LiDE 120, Canon, Japan), and image was produced at a resolution of 300 dpi. Then, the expressed area of the meat area and its surroundings was calculated by Digimizer software (version 5.4.9) and put into equation 3 to obtain WHC (Fig. 1). In this equation, A is the moisture area (leakage) under the ground meat (cm^2) and B is the expressed area of leaking to the surroundings (outer ring) (cm^2) [14]:

$$\text{Expressed juice (\%)} = \frac{m_2 - m_1}{m_s} \times 100$$

[2]

$$\mathrm{WHC} = \left(\frac{B}{A}\right)$$

[3]

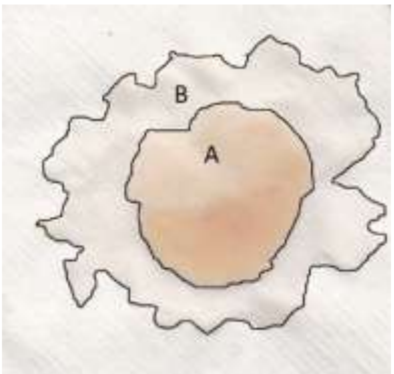

Figure 1- Representative of filter paper impregnated with meat exudate after loading.

Cooking loss

Cooking loss was determined on the third day after slaughter using the Honiell method [13]. For this purpose, about 50 g of meat sample with a thickness of 1.5 cm was weighed and transferred into a plastic zip-bag. Then, the bags were hung in a bain-marie at 80 °C for 1 h to cook the meat. After this period, the bags were removed and cooled under running water. The meat was removed from the package and its surface was blot dried with a tissue paper and weighed. The cooking loss was determined using equation 4, where m1 is the initial weight of the meat and m2 is the weight of the meat after cooking:

$$\text{Cooking loss (\%)} = \frac{m_1 - m_2}{m_1} \times 100$$

[4]

TBA (thiobarbituric acid)

TBA of fillet samples was measured on days 1, 5, 30 and 60 of storage [14]. The samples were taken out of the refrigerator (days 1 and 5) or freezer (days 30 and 60) and ground using an electric grinder. 5 g of the ground meat homogenized with 36 ml of a 5% w/v solution of trichloroacetic acid and 0.5 ml of ethanol containing 0.15% w/v BHT using a homogenizer (T25 IKA, Germany) at a speed of 10,000 rpm for 20 s. Subsequently, 15 ml of distilled water was added to the sample and it was homogenized again for another 10 s at the same speed, then 10 min were allowed for the thiobarbituric acid to be extracted from the homogenate. Then, the samples were filtered through Whatman 42 paper and 2 ml of the filtrate was mixed with the same volume of 0.02 M thiobarbituric acid solution in a test tube. In order to form a malonaldehyde color complex, the tube was placed in boiling water for 20 min. In the control sample, distilled water was used instead of the filtrate. The optical absorbance of the solution was read at a wavelength of 532 nm using a spectrophotometer (Unico S 2100, USA). 3,3,1,1 tetraethoxypropane was used to draw a standard curve and estimate the thiobarbituric acid number in terms of mg malonaldehyde per kg of meat.

Statistical analysis

The experiments were conducted in a completely randomized design. The results of the measurements were analyzed using ANOVA by means of SAS software (version 9.4). Comparison of means was performed using Duncan's test at a probability level of less than 5%. Pearson's correlation test was used to examine the correlation between the results of measuring meat WHC with two different methods and also with drip loss.

3-Results and discussion

pH

The pH measured at 2 and 24 h after slaughter is very important for meat quality, as it is directly related to the proteins and pigments of the meat. Many of important meat attributes such as color, water holding capacity, juiciness, tenderness and shelf life are directly influenced by pH [15]. Fig. 2 shows the effect of different levels of raw and heated PW consumption on the pH of broiler meat. Statistical analysis showed that the pH of broiler meat was affected by the experimental treatments ($p<0.05$), such that the treatments containing raw and heated PW had a higher pH than the control treatment, and this increase in pH was significant in the 25% and 50% PW treatments ($p<0.05$). The highest pH (5.88) was associated with the meat of chickens fed a diet containing 25% HPW, and also, the lowest was for control meat. In the present study, the addition of different levels of PW increased the pH values of breast muscle in the post-mortem period compared to the control. The higher pH of meat of chickens fed PW compared to the control treatment may be due to the fact that PW by reducing glycogen accumulation in meat led to a decrease in the concentration of lactic acid produced during carcass rigor mortis and an increase in pH. This results are consistent with the findings reported in some previous studies [16, 17]. In addition, Zhang et al. [18] investigated the effect of feeding sweet PW on meat quality of broiler chickens. They concluded that the pH of the breast and thigh muscles was significantly higher than that of the control group. At present study, the pH of the breast meat was within the normal range due to the experimental treatments.

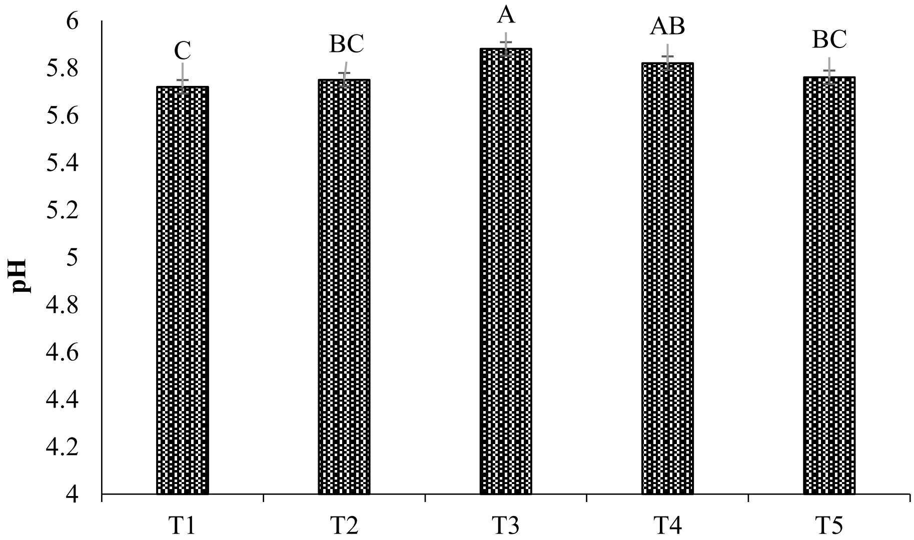

Figure 2- Fillet pH of broiler chickens fed by diets containing different levels of potato waste at 24h postmortem (T1: control, T2: containing 25% raw potato waste, T3: containing 25% of heated potato waste, T4: containing 50% of heated potato waste, T5: containing 50% raw potato waste). Different uppercases on the top of bars indicate significant differences ($p<0.05$).

Drip loss

Drip is a red liquid that mainly consists of water and protein. Drip loss decreases the economic value of meat by reducing 2-10% of meat weight and also creating an undesirable appearance due to purge [19]. The rate and amount of drip formation in fresh meat is affected by rigormortis, pH, WHC, myofibril shrinkage, water permeability of meat cell membranes and other factors such as protein denaturation, time after slaughter, temperature, shape and situation of meat cut inside the package [20]. The results showed that the type of treatment did not have a significant effect on drip loss ($p<0.05$) (Fig. 3). In general, the amount of drip loss in the meat of chickens fed PW was less than the control, but the difference between these 4 treatments was not significant on most measurement days and a logical relationship between the amount of drip loss and both of the content and quality of PW was not found. The reason for this could be related to the high pH of the meat due to potato waste compared to the control treatment, which led to an increase in WHC and a decrease in drip loss. As the time passed, the drip loss values in all samples decreased and this decrease was statistically significant ($p<0.05$). The average drip loss of all treatments was 1.84% on the second day, 1.42% on the fourth day, and 0.99% on the sixth day. The reason for this decrease can be interpreted as follows: after slaughter, the pH decreases and approaches the isoelectric pH (pHI) of most meat proteins, especially actin and myosin (pHI≈5.4-5.5). Simultaneously, the number of homonymous charges on the filaments decreases, and as a result, the repulsion between them decreases and water is removed from the space between the filaments.

In fact, at pHI, the meat has the lowest WHC and the amount of free water is the highest, which is removed from the meat as drip. However, proteolysis of proteins occurs over time, which leads to the production of alkaline compounds and a slight increase in pH. As a result, the electrical charge of proteins is affected by moving away from the pHI and their WHC increases, thereby causing to drip loss decrease. In addition, the degradation of cytoskeletal proteins such as desmin, which is a cross-link between myofibrils, occurs over time, leading to disruption of the connection between myofibrils across the cell and with the sarcolemma, and consequently cell contraction no longer occurs; in other words, the driving forces to flow water into the extracellular space are eliminated [21, 22, 23].

The overall drip loss determined in the six-day period, which is obtained by summing the three measured values for each treatment, was 5.02% for the control, 4.04% for T2, 3.98% for T3, 4.28% for T4, and 3.91% for T5, which indicates the maximum drip loss for the control treatment and the low effect of PW on the drip loss changes. In addition, it can be concluded that delaying the consumption or sale of meat will lead to problems such as reduced quality and nutritional value, and increased economic losses. Contrary to the findings of the present study, Zhang et al. [18] evaluated the effect of sweet PW on the meat quality of broiler chickens and found that drip loss was not alter significantly.

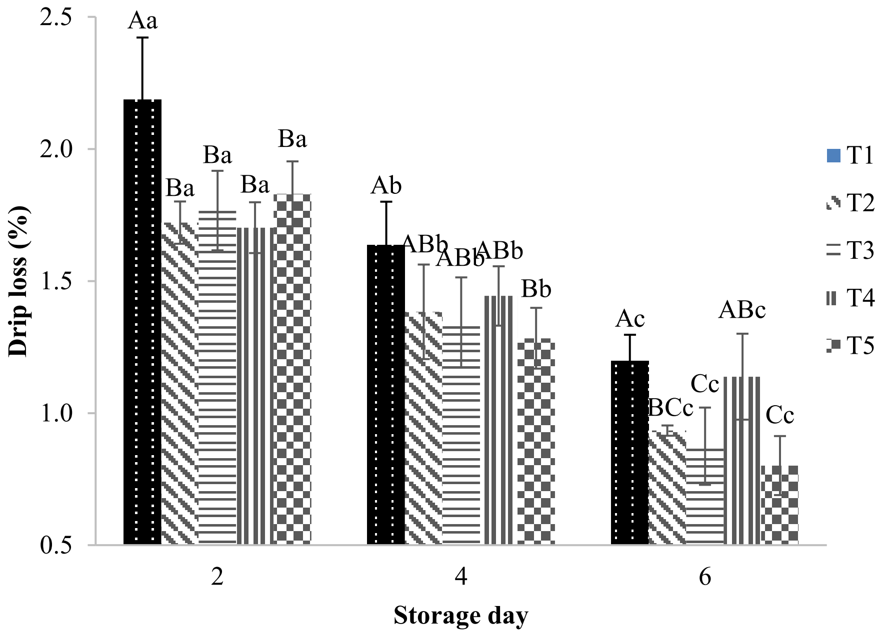

Figure 3- Drip loss values of fillet of broiler chickens fed by diets containing different levels of potato waste at different times of storage (T1: control, T2: containing 25% raw potato waste, T3: containing 25% of heated potato waste, T4: containing 50% of heated potato waste, T5: containing 50% raw potato waste). Different uppercases and lowercases on the top of bars indicate significant differences ($p<0.05$) within a day of storage (among treatments) and during storage, respectively.

Water holding capacity (WHC)

WHC refers to the ability of meat to retain water during operations such as cutting, heating, grinding, and centrifugation [24]. The WHC of meat after slaughter depends on myofibril length, pH, actomyosin formation, and the intensity of oxidative reactions [25]. However, according to Offer et al. [26], muscle pH and protein denaturation are the main determinants of WHC. Meat quality factors such as color, texture, firmness, juiciness, and tenderness are affected by meat WHC [24]. The results showed that the expressed moisture (EM) content was significantly affected by treatments, such that in the meat of chickens fed PW, the EM was lower than that of the control ($p<0.05$) (Fig. 4). On days 2 and 5, the 50% raw PW treatment had the lowest EM, while on day 7, the lowest EM was in the 50% HPW treatment. Therefore, the average values of EM for 50% PW treatments (8.8%) became 1% lower than that of the 25% PW treatments (8.9%) during the storage period, and this difference was not statistically significant, while the EM of these 4 treatments was significantly lower than the control treatment (13.1%). The EM data illustrated a reducing trend over the measurement period ($p<0.05$), so that average values of EM for the days 2, 5 and 7 were calculated to be 11.91, 10.02 and 8.37%, respectively. The decrease can be explained by the increased osmotic pressure of meat cells due to elevated net charges through absorption of K^+ and release of Ca^{2+} as well as proteins' breakdown, followed by increase of WHC [22]. As the pH increases, electrostatic repulsion boosts due to the proteins moving away from the pHI which causes the filaments to move away from each other, increasing the space between the filaments, and reducing the amount of free water [23].

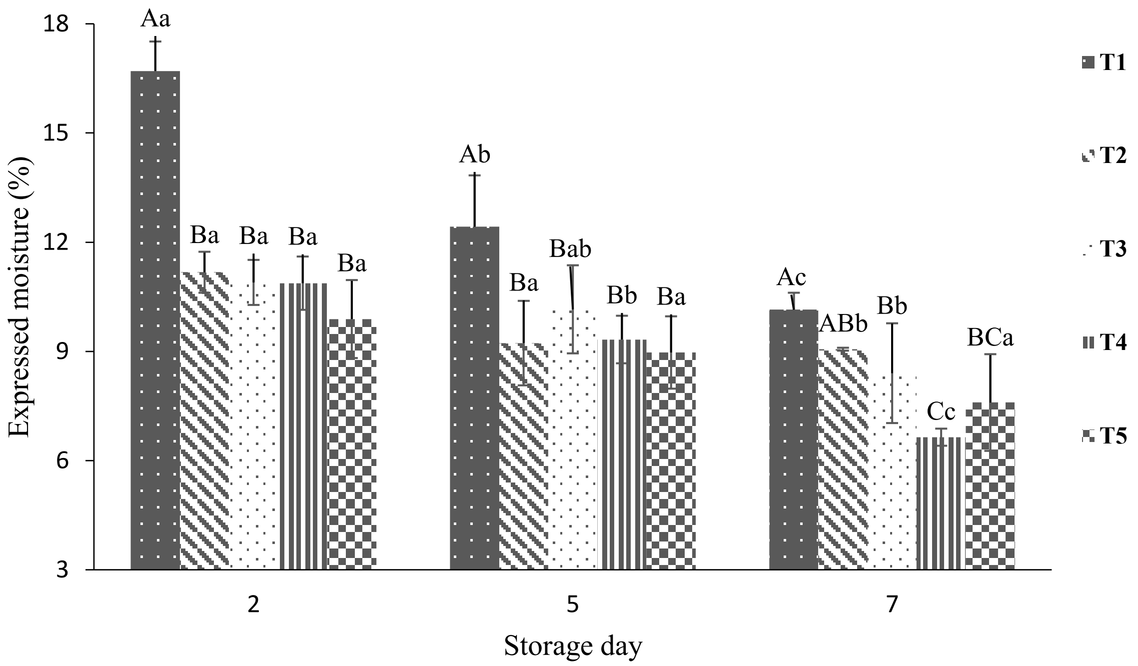

Figure 4- Measurement results of expressed moisture from fillet of broiler chickens fed by diets containing different levels of potato waste at different times of storage (T1: control, T2: containing 25% raw potato waste, T3: containing 25% of heated potato waste, T4: containing 50% of heated potato waste, T5: containing 50% raw potato waste). Different uppercases and lowercases on the top of bars indicate significant differences ($p<0.05$) within a day of storage (among treatments) and during storage, respectively.

The area of the exudate, estimated and reported as the B/A ratio, has an inverse relationship with WHC; in other words, an increase in WHC leads to a decrease in the exudate and, consequently, the B/A. Adding PW to the diet significantly affected the B/A of broilers ($p<0.05$). Similar to the EM results, the evaluation of the B/A also showed that at all times, the amount of exudate in the PW treatments became lower than the control, indicating an increase in WHC of the meat due to the addition of PW. However, the amount of PW and heating did not have a significant effect on the exudate ($p<0.05$). On the second day of measurement, the area of exudate in the PW treatments decreased by two times and reached from 2.77 in the control to 1.36, 1.40, 1.62 and 1.45 for the T2, T3, T4 and T5 treatments respectively. On the fifth day, the difference between control and other 4 treatments decreased and reached from 1.57 in control to 1.17, 0.96, 0.82 and 1.31 for the T2, T3, T4 and T5 treatments respectively, but on the 7th day, the difference between control and the other treatments boosted again, so that there was a threefold difference between them, and the B/A increased from 1.37 in control to 0.49-0.41 in the PW treatments.

The area of EM was also affected by the measurement period ($p<0.05$). In all treatments, the EM decreased over time, which was mainly due to the improvement in WHC. The reduction in B/A in control treatment was about 50%, and in the other four treatments it was 66-74%, and the maximum reduction in B/A was in the treatment with 50% HPW. The increase in WHC in meat from broilers fed PW can be attributed to its antioxidant compounds such as phenolic compounds, carotenoids, and flavonoids. Antioxidants help maintain the integrity of the cell membrane by preventing the oxidation of phospholipids in the cell membrane, thereby decreasing the B/A; because the oxidation of membrane phospholipids reduces membrane fluidity, thereby losing semipermeable property [27, 28]. On the other hand, antioxidants maintain the water storage space between myofibrils and increase water retention capacity by controlling oxidation reactions in meat; because oxidation of fats and proteins and all factors that change the state of myofibril proteins are effective in exudate [25]. In addition, Den Hertog-Meischke et al. [29] stated that the reduction in EM in animals fed diets containing antioxidants could be a result of increased sarcomere length. In support of these mechanisms, Huff-Lonergan and Lonergan [10] reported that meat oxidation resulted in a decrease in susceptibility to hydrolysis, a decrease in water storage between myofibrils, and an increase in EM. Lahučký et al. [30] reported that adding antioxidants to the diet increased the concentration of α-tocopherol and ascorbic acid in meat and reduced the EM. Consistent with the findings of the present study, other researchers have also reported that the use of agricultural waste or other additives in the diet improves the WHC of meat; A study by Abdel Daim et al. [11] indicated that a diet containing potato peel, sugar beet pulp, and enzyme increased the WHC of broiler chicken meat. All three parameters of drip loss, EM and exudatre area (B/A ratio) are directly related to each other; in other words, as the drip loss increases, the EM and B/A should also boost. In order to examine this relationship in the treatments, a Pearson correlation was performed. According to results, there is a positive and significant correlation of 84% between the results of EM and B/A. As the EM decreases, a proportional decrease in surface area of exudate occurs on the filter paper, and changes in one of these two parameters can explain up to 70% of the changes in the other. In conclusion, both methods of determining weight or area of exudate chiefly explain changes in WHC of meat and both methods can be used to determine WHC. A positive and significant correlation was also obtained between the drip loss with EM and, drip loss with the expressed moisture, such that changes in drip loss explained 52% and 60% of EM and B/A changes, respectively (Table 3).

Table 3: Pearson's correlation coefficient of the parameters linked with water holding capacity.

Parameters	Expressed moisture	Drip loss
The area ratio (B/A)	0.84*	0.78*
Drip loss	0.72*	-

*: Significant at p<0.01

Cooking loss

Cooking loss is the combination of soluble solids and liquids lost during cooking of meat. The loss of these substances has economic implications because it reduces the nutritional value of meat due to the loss of some nutrients and consequently decreases the eating quality of the meat (juiciness, mouthfeel and sensory acceptance) [31]. The amount of cooking loss depends on the quality of the raw meat (such as WHC, pHu and amount of connective tissue), the muscle type, the core temperature of the meat and the cooking method (procedure, temperature and time) [32]. Statistical analysis showed that the cooking loss of broiler meat was not affected by the experimental treatments ($p<0.05$) (Table 4); however, the mean cooking loss due to 25% PW was higher than the control and the mean cooking loss due to 50% PW was also higher than the other three treatments. Given that WHC was higher in 4 treatments compared to the control, and their drip loss and expressed moisture were lower, it was expected that cooking loss due to PW would also be lower compared to the control treatment. However, the results obtained indicate that cooking loss due to PW was high. Consistent with the results of this study, the findings of the study by Fiems et al. [33] showed that replacing 60% of the cattle diet with PW did not show a significant effect on cooking loss of beef.

Table 4: Cooking loss values (%) obtained for fillet of broiler chickens fed by diets containing different levels of potato waste on day of 3.

Treatment*	T1	T2	T3	T4	T5	p-value
Cooking loss (%)	24.72±0.84	26.23±0.91	25.98±0.95	26.64±1.20	26.60±0.19	0.26

*: T1: control, T2: containing 25% raw potato waste, T3: containing 25% of heated potato waste, T4: containing 50% of heated potato waste, T5: containing 50% raw potato waste.

TBA

The TBA assay is a privilege method for evaluation the oxidized situation of the stored meats by means of measuring the secondary oxidation products of unsaturated fatty acids, i.e., malondialdehyde (MDA) [34, 35]. According to the analysis of the obtained data, it was proven that TBA values were significantly influenced by treatments ($p<0.05$) (Fig. 5). The detected MDA contents in the chickens' breasts of T4 and T5 treatments were meaningfully lower than that of the control on day 1. Although TBA of the broilers fed by potato waste were statistically the same on day 5, the value of T5 was still significantly less than that of the control ones. On days 30 and 60 of storage, MDA content of the control fillet was remarkably higher than those of the manipulated diets ($p<0.05$). The major antioxidants present in potato are ascorbic acid and polyphenol compounds (chlorogenic acid, cryptochlorogenic acid, caffeic acid, ferulic acid, L-tyrosine, scopolin, etc.), that the latter is the main and contribute 58–82% of the total antioxidant property [36]. These antioxidants may account for the decreased TBA of the fillets obtained from the chickens fed by potato waste. In fact, natural antioxidants are absorbed into the circulatory system ingestion, and then get into tissues and cellular membranes, protecting them from oxidative stress by reactive oxygen [37]. Confirming this finding, eating the cooked unpeeled potato improved the lipid metabolism and antioxidant concentration in cholesterol fed rats. During preparation the HPW, some of the phytonutrients are lost due to oven heating, but some others may be released and result in improving the bioavailability [36]. The lack of TBA difference reflected in responses of the T2 to T5 treatments illustrated the ineffectiveness of heating on the antioxidant capacity of potato waste.

As expected, the storage time was a significant factor for affecting TBA of all treatments, and an increase was detected during two months storage ($p<0.05$). After 5 days of storage, a meaningful enhancement of TBA was found for all treatments, which were even higher than those of the samples stored for two months. This was because of storage conditions of the samples; In fact, the samples used for TBA examinations on days 4 and 5, respectively, were kept in the refrigerator in order to evaluate the antioxidant potential of potato for retarding lipid and protein oxidation, whereas the remaining samples were transferred to the freezer for long-term storage. Nevertheless, more than twice increase in TBA for all treatments were recorded after 5 days' refrigerated storage without being affected by the antioxidant capacity of fillets. After 30 days storage at freezer, TBA of only control sample changed significantly, showing the effect of polyphenols on controlling MDA production in the fillets from broilers fed by PW. However, lipid oxidation slowly progressed under freezing conditions up to the end of storage time, and meaningful increase of TBA was recorded for T2 to T5 treatments. TBA values of the present work were laid in the range of 0.32-0.45 mg MDA/kg of fillet after two months storage at -20 °C, which were much lower than the defined allowable limits.

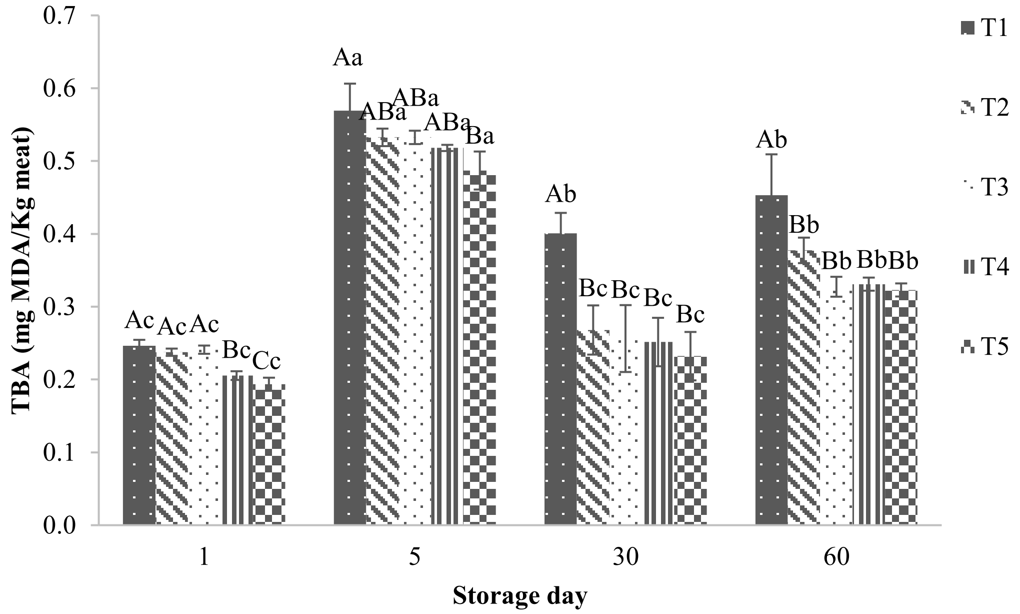

Figure 5- The effect of dietary treatments on TBA values (mg MDA/kg of fillet) of broiler chickens' breast at different times of storage (T1: control, T2: containing 25% raw potato waste, T3: containing 25% of heated potato waste, T4: containing 50% of heated potato waste, T5: containing 50% raw potato waste). Different uppercases and lowercases on the top of bars indicate significant differences ($p<0.05$) within a day of storage (among treatments) and during storage, respectively.

4-Conclusion

The present study was conducted to investigate the effect of adding potato waste to the diet of broiler chickens on some quality characteristics of breast meat. In general, the use of different levels of raw and heated potato waste had a positive effect on the quality of broiler chicken meat, leading to an increase in WHC and a decrease in drip loss and TBA, and did not have a negative effect on other properties except for pH, which is preferably lower values for better preservation. In order to select the best treatment from the perspective of meat quality, the effect of this dietary replacement on other physicochemical, qualitative and sensory factors in addition to breast muscle should be investigated in future studies.

Essentials:

Data Availability

There are no confidential data in this article and all data are fully and accurately reported and available to the public.

Do you have any financial or personal conflicts of interest?

None to declare.

Was this research funded by any source?

This research did not receive any specific financial support from government, commercial, or non-profit organizations.

Did all authors participate in the design, analysis, writing, and approval of the final manuscript?

Yes, we confirm that all authors participated in the design, analysis, writing, and approval of the final manuscript.

5-References

[1] Kralik, G., Kralik, Z., Grčević, M. & Hanžek, D. Quality of chicken meat. 2018. Animal Husbandry and Nutrition, Ed by: Yucel, B. & Taskin T. BoD publications.

[2] Sharada, M. S., Indumathi, J., Reddy, G. B., Shakila, S., & Mouli, A. C. 2025. Effect of incorporation of potato dried powder on the quality characteristics of spent broiler breeder hen chicken koftas. International Journal of Bio-Resource and Stress Management, 16(7).

[3] Vahedipour-Dahraie, S., Zahedi, Y., GhannadIasl, F., & Shakouri, M. D. 2023a. The effect of eugenol and butyric acid glycerides on the qualitative and sensory properties of chicken fillet. Journal of Food Science and Technology 19, 133, 281-295.

[4] Vahedipour-Dahraie, S., Zahedi, Y., Ghannadiasl, F., & Shakouri, M. D. 2023b. Investigation into the qualitative changes of fillet of broiler chickens fed by diet containing eugenol and butyric acid glycerides. Food Research Journal, 33(3), 67-82.

[5] Dugassa, S., Demeke, S., Mohammed, A., Diba, D., Yusuf, H., & Gobena, G. 2023. Growth Performance and Carcass Characteristics of Cobb 500 Broiler Chicken Fed Potato Peel Meal as a Partial Substitute of Maize. Journal of Science, Technology and Arts Research, 12(3), 1-12.

[6] Idrissa, Y., Amaza, I., Musa, A., Garba, A., Madaki, A., Ibrahim, A., Mohammed, A., Zango, M., Baraya, H., & Mohmmed, A. 2025. Irish potato peel as a maize substitute in broiler chicken diets: impacts on growth performance, carcass yield and feed cost. FUDMA Journal of Animal Production and Environmental Science, 1(2), 23-28.

[7] Tadesse, T. 2021. Review on feed resources with more emphasis on use of cassava and sweet potato meal in chicken diet: Ethiopia. Animal and Veterinary Sciences, 9(2), 32-38.

[8] Bagheri, M. 1398. Using potato waste in livestock and poultry feeding. 4th International Congress of Developing Agriculture, Natural Resources, Environment and Tourism of Iran. (Pr).

[9] Chashnidel Y., Kolarestani, H., Jafari Sayadi A.R. 2019. Replacing barley with different levels of cooked potato wastes in diet on growth performance, apparent digestibility of nutrients and qualitative and quantitative characteristics of carcasses of fattened Zell male lambs. Journal of Ruminant Research. 7 (3): 13-26.

[10] Huff-Lonergan, E., & Lonergan, S. M. 2005. Mechanisms of water-holding capacity of meat: The role of postmortem biochemical and structural changes. Meat science, 71(1), 194-204.

[11] Abdel-Daim, A. S. A., Tawfeek, S. S., El-Nahass, E. S., Hassan, A. H. A., & Youssef, I. M. I. 2020. Effect of feeding potato peels and sugar beet pulp with or without enzyme on nutrient digestibility, intestinal morphology, and meat quality of broiler chickens. Poultry Science Journal, 8(2), 189-199.

[12] Al-Harthi, M. A., & Attia, Y. A. 2016. Effect of citric acid on the nutritive value of olive cake in broiler diets. European Poultry Science 2016a, 1-14.

[13] Honikel, K.O. 1998. Reference methods for the assessment of physical characteristics of meat. Meat Science, 49: 447-457.

[14] Vahedipour-Dahraie, S., Zahedi, Y., & Shakouri, M. D. 2024. Effect of eugenol and butyric acid glycerides dietary supplementation on the fillet quality of chickens. Journal of Applied Poultry Research, 33(3), 100438.

[15] Mendes, A. A., Moreira, J., & Garcia, R. G. 2003. Qualidade da carne de peito de frango de corte. Revista Nacional da Qualidade da Carne, 28(317).

[16] Zakaria, H. A., Jalal, M. A., & Ishmais, M. A. A. 2010. The influence of supplemental multi-enzyme feed additive on the performance, carcass characteristics and meat quality traits of broiler chickens. International Journal of Poultry Science, 9(2), 126-133.

[17] Dalólio, F. S., Vaz, D. P., Moreira, J., Albino, L. F. T., & Valadares, L. R. 2015. Carcass characteristics of broilers fed enzyme complex. Biotechnology in Animal Husbandry, 31(2), 153-162.

[18] Zhang, X., Zhang, Y., Ijiri, D., Kanda, R., & Ohtsuka, A. 2019. Effect of Feeding a Dry-Heat-Processed Sweet Potato Waste on the Growth Performance and Meat Quality of Broilers. Nihon Danchi Chikusan Gakkaihou, 62(2), 107-114.

[19] Offer, G., and Cousins, T. 1992. The mechanism of drip production: Formation of two compartments of extracellular space in muscle post mortem. Journal of the Science of Food and Agriculture, 58: 107-116.

[20] Fischer, K. 2007. Drip loss in pork: influencing factors and relation to further meat quality traits. Journal of Animal Breeding and Genetics, 124: 12-18.

[21] Kristensen, L., and Purslow, P.P. 2001. The effect of ageing on the water-holding capacity of pork: role of cytoskeletal proteins. Meat Science, 58: 17-23.

[22] Lawrie, R.A. 1998. Meat Science. Pergamon Press., New York.

[23] Dransfield, E., & Sosnicki, A. A. 1999. Relationship between muscle growth and poultry meat quality. Poultry science, 78(5), 743-746.

[24] Huff-Lonergan, E. 2002. Water-Holding Capacity of Fresh. Meat American Meat Science Association.

[25] Wood, J. D., & Enser, M. 1997. Factors influencing fatty acids in meat and the role of antioxidants in improving meat quality. British journal of Nutrition, 78(1), S49-S60.

[26] Offer, G., Knight, P., Jeacocke, R., Almond, R., Cousins, T., Elsey, J., & Purslow, P. 1989. The structural basis of the water-holding, appearance and toughness of meat and meat products. Food structure, 8(1), 17.

[27] Asghar, A., Gray, J. I., Booren, A. M., Gomaa, E. A., Abouzied, M. M., Miller, E. R., & Buckley, D. J. 1991. Effects of supranutritional dietary vitamin E levels on subcellular deposition of α-tocopherol in the muscle and on pork quality. Journal of the Science of Food and Agriculture, 57(1), 31-41.

[28] Jensen, C., Lauridsen, C., & Bertelsen, G. 1998. Dietary vitamin E: quality and storage stability of pork and poultry. Trends in food science & technology, 9(2), 62-72.

[29] Den Hertog-Meischke, M. J. A., Smulders, F. J. M., Houben, J. H., & Eikelenboom, G. 1997. The effect of dietary vitamin E supplementation on drip loss of bovine longissimus lumborum, psoas major and semitendinosus muscles. Meat science, 45(2), 153-160.

[30] Lahučký, R., Bahelka, I., Novotná, K., & Vašíčková, K. 2005. Effects of dietary vitamin E and vitamin C supplementation on the level of α-tocopherol and L-ascorbic acid in muscle and on the antioxidative status and meat quality of pigs. Czech J Anim Sci, 50, 175-184.

[31] Bejerholm, C., Aaslyng, M.D., and Jensen, W.K. 2004. Cooking of meat. In: Encyclopedia of Meat Sciences, Elsevier, Oxford.

[32] Lee, D. W., Shin, J. H., Park, J. M., Song, J. C., Suh, H. J., Chang, U. J., ... & Kim, J. M. 2010. Growth performance and meat quality of broiler chicks fed germinated and fermented soybeans. Food science of animal resources, 30(6), 938-945.

[33] Fiems, L. O., De Boever, J. L., Vanacker, J. M., & De Brabander, D. L. 2013. Effect of cull potatoes in the diet for finishing Belgian Blue double-muscled cows. Animal, 7(1), 93-100.

[34] Kahraman, T., G. Issa, E. B. Bingol, B. B. Kahraman, & E. Dumen. 2015. Effect of rosemary essential oil and modified-atmosphere packaging (MAP) on meat quality and survival of pathogens in poultry fillets. Brazilian Journal of Microbiology. 46:591-599.

[35] Karabagias, I., A. Badeka, & M. Kontominas. 2011. Shelf life extension of lamb meat using thyme or oregano essential oils and modified atmosphere packaging. Meat Sci. 88:109-116.

[36] Raigond, P., B. Singh, S. Dutt, & S. K. Chakrabarti. 2020. Potato: Nutrition and Food Security. Springer Nature, Singapore.

[37] Al-Obaidi, A. S., A. B. Mahmood, Z. K. Khidhir, H. G. Zahir, Z. T. Al-doori, and H. O. Dyary. 2021. Effect of different plants aromatic essential oils on frozen Awassi lamb meats chemical and physical characteristics. Italian Journal of Food Science. 33:98-106.

مجله علوم و صنایع غذایی ایران

سایت مجله: www.fsct.modares.ac.ir

مقاله علمی_پژوهشی

بررسی اثر جایگزینی بخشی از ذرت جیره غذایی جوجه‌های گوشتی با ضایعات سیب زمینی روی برخی ویژگیهای فیزیکی-شیمیایی گوشت سینه

یونس زاهدی*[۱]، آرزو نصرتی امین‌جان[۲]، میر داریوش شکوری[۳]، سورنا واحدی‌پور دهرائی[٤]

۱- دانشیار گروه علوم و مهندسی صنایع غذایی، دانشگاه محقق اردبیلی، اردبیل، ایران.

۲- دانش‌آموخته کارشناسی ارشد علوم و مهندسی صنایع غذایی، دانشگاه محقق اردبیلی، اردبیل، ایران.

۳- دانشیار گروه علوم دامی، دانشگاه محقق اردبیلی، اردبیل، ایران.

٤- دانش‌آموخته کارشناسی ارشد علوم و مهندسی صنایع غذایی، دانشگاه محقق اردبیلی، اردبیل، ایران.

اطلاعات مقاله

تاریخ های مقاله :

تاریخ دریافت: ۱٤۰٤/۰۷/۰٦

تاریخ داوری: ۱٤۰۵/۰۲/۰۲

تاریخ پذیرش: ۱٤۰۵/۰۲/۳۰

کلمات کلیدی:

جوجه گوشتی،

ضایعات سیب‌زمینی،

اصلاح جیره،

کیفیت گوشت.

DOI: 10.48311/fsct.2026.116662.1004

* مسئول مکاتبات:

younes.zahedi@gmail.com

Y_zahedi@uma.ac.ir

چکیده

هدف از پژوهش، جایگزینی بخشی از ذرت جیره جوجه‌های گوشتی با ضایعات سیب‌زمینی و بررسی اثرات آن روی ویژگی‌های فیزیکی-شیمیایی گوشت ناحیه سینه بود. این پژوهش به‌صورت یک طرح کاملاً تصادفی با پنج تیمار و چهار تکرار طراحی و اجرا شد. در هر پن، تعداد ۱٦ قطعه جوجه گوشتی به‌طور یکنواخت جایگذاری گردید. تیمارهای آزمایشی شامل: ۱)شاهد، ۲)جیره حاوی ۲۵٪ ضایعات سیب‌زمینی خام، ۳)جیره حاوی ۲۵٪ ضایعات سیب‌زمینی حرارت‌دیده، ٤)جیره حاوی ۵۰٪ ضایعات سیب‌زمینی حرارت‌دیده، و ۵)جیره حاوی ۵۰٪ ضایعات سیب‌زمینی خام بودند. پس از گذشت ٤۲ روز دوره پرورش، جوجه‌ها کشتار شدند و گوشت ناحیه سینه جهت انجام آزمایش‌های مورد نظر انتخاب گردید. نتایج ارزیابی‌ها نشان داد استفاده از ضایعات سیب‌زمینی خام و حرارت‌دیده سبب افزایش pHنهایی گوشت سینه در تیمارهای ۳ و ٤ شد(p<۰/۰۵). با گذشت زمان افت خونابه گوشت تقلیل یافت(p<۰/۰۵). ظرفیت نگهداری آب گوشت (WHC) تحت تاثیر تیمار و زمان نگهداری قرار گرفت(p<۰/۰۵)؛ در تیمارهای تغذیه شده با ضایعات سیب‌زمینی خام و حرارت دیده، مقدار شیرابه خروجی (EM) از گوشت کمتر از تیمار شاهد بود و میانگین EM تیمارهای ۲ و ۳ برابر با ۹/۸٪ و تیمارهای ٤ و ۵ برابر با ۸/۸٪ بود که کمتر از تیمار شاهد (۱۳/۱٪) بود. جایگزین کردن ضایعات سیب‌زمینی در تغذیه جوجه‌ها روی افت پخت گوشت سینه بی‌تاثیر بود(p>۰/۰۵). استفاده از ضایعات سیب‌زمینی به‌دلیل دارا بودن ترکیبات آنتی‌اکسیدانی سبب کاهش شاخص فساد TBA گردید(p<۰/۰۵). در مجموع، جایگزینی بخشی از ذرت با ضایعات سیب‌زمینی سبب بهبود WHC و کاهش TBA شده و پتانسیل استفاده در جیره غذایی جوجه‌های گوشتی را دارد.