Original Article
DOI: https://doi.org/10.70749/ijbr.v2i02.313

INDUS JOURNAL OF BIOSCIENCES RESEARCH
https://induspublisher.com/IJBR
ISSN: 2960-2793/ 2960-2807

Quality Assessment of Meat via Pomegranate (Punica Granatum L.) Waste-Enriched Chicken Feed

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ARTICLE INFO

Keywords

Pomegranate Waste, Waste Management, Broiler Chicken, Meat Quality, Feed Enrichment.

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Declaration

Author's Contributions: All authors contributed to the study and approved the final manuscript.
Conflict of Interest: The authors declare no conflict of interest.
Funding: No funding received.

Article History

Received: 05-10-2024
Revised: 29-11-2024
Accepted: 13-12-2024

ABSTRACT

This study aimed to assess the impact of dietary supplementation with pomegranate seed powder (PSP) on the growth performance and meat quality of broiler chickens while exploring its potential as an environmentally friendly feed additive. A total of 120 Cobb broiler chicks were randomly assigned to four dietary treatments: PSP0 (Control, 0% PSP), PSP1 (0.5% PSP), PSP2 (1% PSP), and PSP3 (1.5% PSP), with five replicates of eight birds per group. PSP supplementation was administered during weeks 4 and 5 of the growth period, and growth performance, carcass quality, and meat attributes were evaluated.

The results showed that in week 4, PSP3 increased average weekly feed intake (AWFI) and feed conversion ratio (FCR), while in week 5, PSP2 improved live bird weight (LBW) compared to the control. However, body weight gain (BWG) and organ weights of various carcass components, including breast, heart, liver, drumstick, thigh, and neck, remained non-significant across all groups. Meat quality analysis revealed no significant effects of PSP on fat content, pH, moisture, ash, or instrumental color parameters (brightness, redness, and yellowness). Organoleptic assessment found that raw PSP3 samples were harder, while cooked samples exhibited greater hardness but reduced springiness and juiciness compared to raw meat.

In conclusion, incorporating PSP into chicken diets offers a sustainable solution for reducing environmental waste without adversely affecting growth performance, organ weights, or meat quality. This approach underscores the potential of agricultural by-products in animal nutrition.

INTRODUCTION

Punica granatum is the botanical name for the fruit plant pomegranate. It is the primary plant of the Lythraceae group and is found all over the world (Mukama, Ambaw, Berry, & Opara, 2019). Pomegranate peel is an inedible component of the fruit that accounts for half of the fruit weight i.e., 50% (Mphahlele, Fawole, Makunga, & Opara, 2016). The outer layer is used to treat diarrhoea, worm infection, as well as pregnancy complications. This plant's fruits are used to make a variety of items like jelly, juice, as well as squash. Furthermore, they are utilized to enhance the flavor and colour of various beverages (Mousavinejad, Emam Djomeh, Rezaei, & Khodaparast, 2009). This fruit is considered an ancient fruit that has been used in traditional remedies (Çam *et al.*, 2014). It may have anti-cancer, anti-oxidant, anti-microbial, anti-mutagenic, and anti-viral properties (Negi, Jayaprakasha, & Jena, 2003). This plant's fruit is divided into three parts: the juice, seeds, and skin (Lansky & Newman, 2007). Punicalagin is a polyphenolic substance isolated from pomegranate juice that exhibits considerable anti-oxidant activity (Adams *et al.*, 2006; Seeram *et al.*, 2005). Moreover, the fruit of Pomegranate is considered a main ingredient used in folk medicines to cure several ailments because it comprises vitamin C anthocyanins, hydrolyzable tannins, and acids (Malik *et al.*, 2005). The pomace of fruit can be derived through the juice extraction process by pressing the fruits and has the potential to act as an antioxidant agents, thereby preventing oxidation (Duran *et al.*, 2016). Furthermore, it also has high antioxidant activity (Azizi *et al.*, 2018), fat reduction properties (Khajebishak *et al.*, 2019), anti-cancer potential (Mehta and Lansky, 2004), and blood sugar level regulation characteristics (Yamasaki *et al.*, 2006). The peel of pomegranate has a significant anti-oxidant activity (Li *et al.*, 2006) and accounts for over half of the entire fruit weight (Seeram *et al.*, 2005). The peel and rind of this fruit are high in tannins, anthocyanins, and flavonoids (Naveena *et al.*, 2008) and protect humans from major illnesses like cancer and diabetes (Sturgeon and Ronnenberg, 2010). As a waste, the beverage sector produces pulp, roots, seed and skin of the fruits after juice extraction. As a result, the amount of waste generated is approximately 25-30% (Sagar *et al.*, 2018) and it is believed that almost one-third of all food produced worldwide is lost each year (FAO, 2011). Because fruit waste is particularly nutritious, it can be utilized by incorporating it into raw feed ingredients for animals, resulting in the production of high-quality feeds (Kasapidou *et al.*, 2015). 10% of the pomegranate seeds are left over after the fruit juice has been extracted (Abbasi *et al.*, 2008). The fruit's fatty acids and high-quality protein are abundant in this waste (12–24%) (Tian *et al.*, 2013) with 10 to 20% proteins and 30 to 50% insoluble fibers (Taher *et al.*, 2012; Uçar *et al.*, 2009).

Nowadays, balanced nutrition is a major concern, and its effective management is impossible without meat consumption (Oughton and Ritson, 2007). According to estimates, the daily protein intake should be 0.67 g of protein per kg carcass mass (EFSA Panel on Dietetic Products & Allergies, 2012). According to FDA data, a recommended value of protein consumption is 0.8 g protein/BW or around 50 g of meat each day and the acceptable range for Macronutrient Distribution suggests that protein consumption should account for 10-35% of daily caloric intake (Food and Nutrition Board, 2005). Chicken is widely available, simple to obtain, easier to handle and produce, affordable, and has an appealing nutritional profile (Marangoni et al., 2015). Research comparing the nutritional content of different forms of meat revealed that chicken meat has a higher bioavailability of protein than other meats (Menezes *et al.*, 2018). Additionally, chicken flesh is a source of B group vitamins, a low lipid profile, and various mineral components like selenium, iron, and other minerals (Lombardi-Boccia *et al.*, 2002). Each year, the average global intake of chicken flesh increases to about 14.2 kg. While in Pakistan (2018), each person consumes about 4.547 kg of chicken annually (OECD, 2019). The presence of light, firm, non-exudative and light, elastic exudative meat are the main concerns with farming (chicken) (Carvalho *et al.*, 2018) along with the number of birds per pen, money shortages, a lack of chicken equipment and sufficient information about chicken rearing (Naeem and Khan, 2019; Rakib, 2018) as a result meat spoilage in farms and processing companies occurs and chicken meat production will eventually decline (Durgga and Subhadra, 2009).

When compared to other meat sources, chicken meat is in high demand because of its exceptional qualities *i.e.*, higher protein, lower fat and relatively greater proportion of poly-unsaturated fatty acids (Ahmed *et al.*, 2015). The waste obtained from fruits contains a significant amount of fatty acids. Therefore, it can be a valued source of fat in chicken nourishment (Hosseini *et al.*, 2016). Pomegranate use as a feed supplement for poultry has not received much research to now. Management of fruit and vegetable waste is a significant issue, particularly in underdeveloped nations. Additionally, it harms the ecosystem

(Obuobi *et al.,* 2022). Several methods of proper waste management should be investigated to overcome this issue. Furthermore, there is a big market for broiler meat. However, broiler chicken malnutrition and reduced immunity are ongoing issues in the industry (Hafez and Attia, 2020). In this context, replacing synthetic feed additives with fruit waste in chicken feed has the potential to be advantageous. The study examined the effects of powered pomegranate waste in chicken feed on chicks' growth, meat quality, and consumer approval.

MATERIALS AND METHODS

Treatments and design

The purchased 120 Cobb broilers having an age of 21 days were categorized into four groups in net cages randomly. The treatments were planned as: 0% (control, non-supplemented grouping), 0.5%,1%, 1.5, and PSP. The chicks in each group were fed a commercial diet for the first three weeks and a PSP-supplemented diet for the fourth to sixth weeks (Caleb *et al.,* 2013).

Growth Performance Evaluation

Different parameters of feed intake like weekly weight gain (WG), weight gain percentage (WGP), live-bird weight (LBW), and feed conversion ratio (FCR) were used to evaluate broiler growth and performance. Six birds (n=6) were chosen at random from each treatment and checked for their development and performance on days twenty-one, twenty-eight, thirty-five, and forty-two (Nafees *et al.,* 2018; Yuan et *al.,* 2018). After slaughter, three broilers of the same size and weight were chosen at random (n=3) from every single treatment and evaluated for processing and sensorial quality parameters. The feed intake and live body weight of every single treatment was calculated by the method of Batchelor et al. *(*2018). The weekly feed conversion ratio (FCR) was calculated using (Zhang *et al.,* 2014).

Meat Value Evaluation

After the raising trial, the birds kept fasted for a small number of hours. Three broilers from every set were chosen and slaughtered using the Halal procedure concerning the animal welfare requirements outlined in Pakistan Standards and Quality Control Authority's PS-3337:2016 (Mustafa *et al.,* 2016).

a) Weight of Meat Cuts

After slaughter, the blood was completely drained. Later on, the removal of feet and head was performed, and they were dressed and eviscerated. Within 15-20 min of slaughter, the meat was portioned at room temperature (252°C). Using a weighing balance, the measurements of weight for different organs and parts (thighs, carcass, boneless breast, neck, liver, and heart) were recorded (Model AUW320, Shimadzu, Japan). Later, the sterilized low-density polyethylene packets were utilized to pack all the above-mentioned parts and then placed at cool temperatures i.e. 0 to 4°C to minimize the interior temperature of meat up to 4°C which is further needed for the examination of meat quality.

b) pH

The pH of breast samples was measured at different locations with a deepness of 2.5 cm after 30 to 45 min of post-slaughtering using a pH meter (WTWTM, SentixTM 41, Model B161609100, Germany).

c) Moisture and Ash content

The amount of ash and moisture of chicken meat samples from each treatment were determined using a muffle furnace and hot air oven by the protocol of AOAC (2016).

Instrumental Color

The end users always pay attention to color because they take it as an indication of freshness and healthiness, color is the most important factor in purchasing (Natalello *et al.,* 2020). The color of the portion of meat taken from the breast was analyzed by using a color detection app that was downloaded from the Android Play Store (Color Grab, Loomatix). Before analysis, the chicks (Cobb broilers) were given a feed supplemented with leftover pomegranate which was prepared after 04 different processing circumstances which further includes room temperature (25°C), cooking at a temperature of 80°C for a time duration of 15 minutes, refrigeration at a temperature of 4°C for 72 hours and finally the compression by applying the force of 20 kg * 9.8 = 196 N for 15 min. The impact of processing and pomegranate supplemented diet on the color of breast portion was assessed using CIE L*, a*, and b* figures, which are the indications of darkness over lightness (0 to 100), redness over greenness (+ or – a*), and yellowness over blueness (+ or – b*) in case of broiler red meat (Küçüközet & Uslu, 2018). The color parameters of three different chicken breast samples were measured by app (Color Grab, Loomatix) placing the camera's aperture upright 04 cm directly above the meat portions. Likewise, hue angle (h°) and chroma (C*) values were also determined. By cutting the tissue portion transversally to a thickness, and b values according to the formulae below, the color readings (L*, a*, and b*) of specimens were recorded.

Sensory Analysis

The organoleptic analysis of the breast portion of chicks was carried out by the panel. Sensory evaluation was carried out to evaluate juiciness, hardness, taste, color, aroma, springiness, and overall acceptability for sliced portions each weighing approximately 02 gm and 03 mm of thickness (Yang *et al.*,, 2016).

STATISTICAL ANALYSIS

The results obtained from the study were evaluated through the Statistical (Version 8.1, USA) program using one-way ANOVA under Factorial Design with a significance level of 0.05. The values were presented as Means Standard Deviation (S.D).

RESULTS AND DISCUSSION

Growth

As the number of weeks grew, the effect of PSP-enhanced poultry feed on broiler chickens' average weekly consumption of feed (AWFI) increased dramatically. The associations of treatments* weeks were non-significant in the case of AWFIs in chickens. The AWFI improved non-significantly as the PSP dose rose. The AWFI rises as the number of weeks increases. In the 5th week (W5), AWFI is strong at the end of growth periods. The lowest value was found for control, and the highest value was found for PSP3. Cobb broilers had the highest AWFI (1.05) at the end of the expansion period, followed by week 4 (0.87) and week 3 (0.05) in that order. Average weekly feed intake varies from treatment to treatment. PSP0 at W1 is low (0.49) but highest at PSP3 W5 (1.05). Sharifian et al. (2019) observed substantial results using varied proportions of pomegranate seed (0.1, 0.2, 0.3 and 0.5) in the feed. The average consumption of feed at 0% was 96.08 g, which declined as the feed% increased, 90.53 g at 0.50%, and 89.45 g at 1% (Badawi and Gomaa, 2016).

Table 1

Cobb broiler chick average daily diet intake

PSP0	3rd Week	4th Week	5th Week
	0.49±0.01d	0.78±0.02c	1.04±0.03a
PSP1	0.51±0.04d	0.84±0.03bc	1±0.08a
PSP2	0.48±0.02d	0.83±0.03bc	1±0.10a
PSP3	0.5±0.05d	0.87±0.01b	1.05±0.07a

PSP= pomegranate seed powder while, PSP0, PSP1, PSP2 and PSP3= doses at 0,0.5, 1 and 1.5 % PSP in the basal diet. Different letters depict significant difference in results (p<0.05, n=40).

The primary effect of pomegranate seed fine particulates on chicks LWB was insignificant. Weekly live bird weight grows with time and reaches a maximum at the end of the fifth week, with a minimum at the start of the first week. PSP0 in W3 has a minimum live bird weight of (0.5) and a maximum live bird weight of (1.62) in PSP2 in W5. Cobb broilers had the highest LBW (1.62) near the end of the growing period, followed by week 4 in the third week. The current study's LBW trend revealed a usual growing pattern as the number of weeks increased. A research done by Hamady et al. in 2015 used pomegranate peel extract which showed that the pomegranate group had more live body weight than the control group. The BWG has risen significantly in recent weeks, culminating near the conclusion of the fifth week. PSP0 experienced the least weight gain in the fourth week, whereas PSP3 experienced the most. The consequence of PSP supplements on weekly WG was a significant balance to manage broiler collecting. Cobb broilers had the highest WG (g) values in the research. In comparison to week 5 (0.51) and week 4 (0.56). The current data demonstrated that PSP enrichment had a significant impact on the WG of Cobb broiler chickens, and they aligned with previous studies by Kamel et al. (2021). Sharifian et al. (2019) found substantial effects of 250 mg and 450 mg PSP supplementation on broiler chicken weight gain. Ahmad et al. (2021) using varied percentages of pomegranate found that increasing the percentage of PSP marginally reduced body weight gain.

Figure 1.

Broiler's live bird weight (left) and Cobb broiler chicks' weekly live-bird weight, PSP= pomegranate seed powder while, PSP0, PSP1, PSP2, and PSP3= doses at 0 %, 0.5 %, 1% and 1.5 % PSP in the basal diet and error bars with different letters depicts the significant difference in results (p<0.05, n=40).

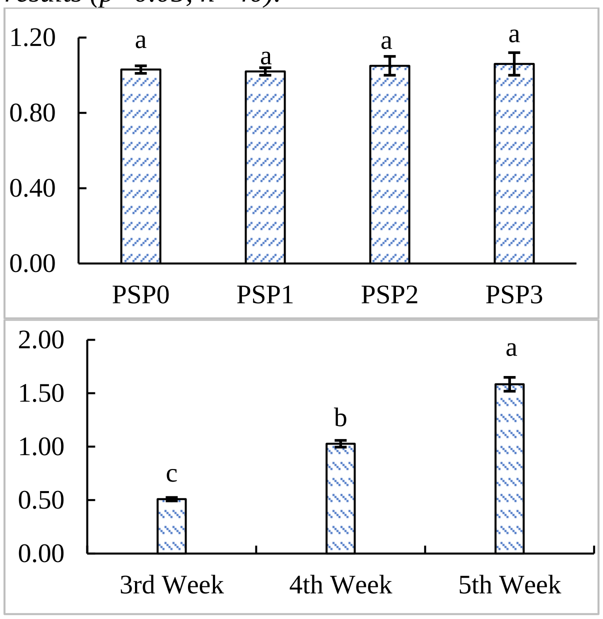


Table 2

Broiler chicken weight gain as a function of treatments and days

	4th week	5th week
PSP0	0.51±0.02a	0.56±0.01a
PSP1	0.52±0.03a	0.53±0.05a
PSP2	0.53±0.06a	0.54±0.05a
PSP3	0.51±0.02a	0.56±0.06a

PSP= POMEGRANATE SEED POWDER, PSP0, PSP1, PSP2 AND PSP3= DOSES AT 0,0.5,1 AND 1.5 % PSP IN THE BASAL DIET. DIFFERENT LETTERS DEPICTS THE SIGNIFICANT DIFFERENCE IN RESULTS (P<0.05, N=40).

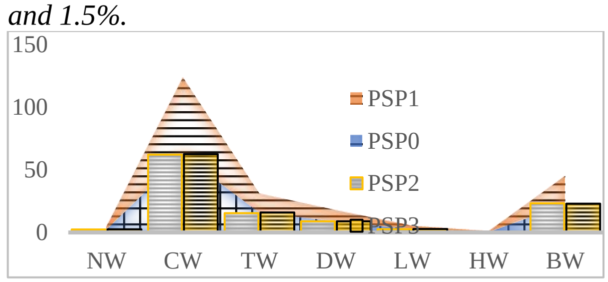
Meat Quality

Organ Weights

The analysis of variance determined that the PSP supplementation in the broiler diet resulted non-significant result in the breast weights of the Cobb chicks (figure 2). In the current study, the supplementation of broiler feed with PSP resulted in weight gain ranging from 22.17±1.02 to 23.00±0.51% with the respect to mean bird weight of *Cobb* broilers. These weights were somewhat greater than the (Zhang *et al.*, 2020) breast weights and found breast weight ranging from 16.5 to 18.6% of the total weight. PSP supplementation in the chicken diet had no effect on the heart weight of Cobb broiler chicks. PSP fortification of broiler feed enabled a heart weight growth ranging from 0.40±0.03 to 0.48±0.05% of the mean live bird body weight. These heart weights were consistent with those discovered by (Zhang *et al.*, 2020), who researched the effect of bedcover resources on hen limb heaviness and established a heart heaviness percentage ranging from 0.48 to 0.58% (of the LBW). The current findings are congruent with those of (Sánchez *et al.*, 2016), who discovered a non-significant affect on heart weight percentages. The effect of pomegranate inclusion in hen feed on Cobb broiler chicken liver weight showed that pomegranate supplements have no effect on the liver weight of Cobb broiler chicks. The ANOVA revealed that the inclusion of pomegranate seed powder in the chicken diet resulted in a non-significant increase in the liver weight of the Cobb broiler chicks. PSP addition of broiler feed resulted in liver weight growth ranging from 2.59±0.26 to 2.76±0.08% of the mean live bird weight. The liver weights in this investigation were consistent with those in Yaseen et al. (2014), which found no effect of pomegranate upon liver weight percentage.

Figure 2

Organ weight of Cobb broiler chicken after PSP supplementation in feed where NW=neck weight, CW= caracass weight, TW= thigh weight, DW=drumstick weight, LW= liver weight, HW= heart weight, BW=breast weight and PSP0 represents that the chickens were fed a basal diet without any supplement, whereas PSP1, 2, and 3 represent that the feed was supplemented by pomegranate seed powder at levels of 0.5%, 1%, and 1.5%.



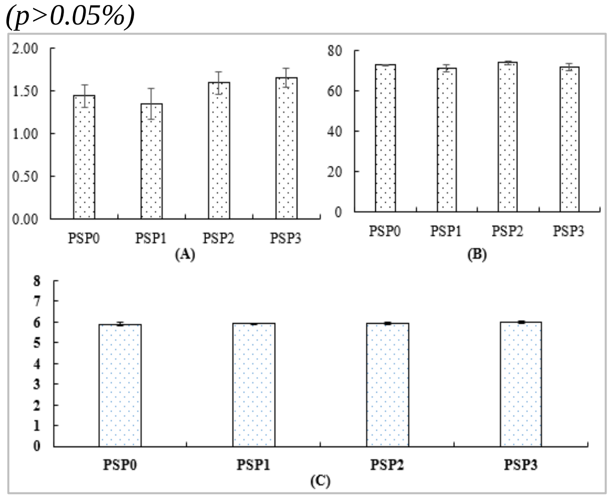
The impact of pomegranate seed powder enrichment in the broiler feed on the weights of Cobb chicken broiler drumsticks revealed that pomegranate seed powder supplementation in the broiler food had no effect on the Cobb chicken's drumstick weights. In the current study, adding PSP to broiler feed increased the weight gain of drumsticks by 8.89±0.94 to 8.99±0.46% as compared to the mean bird weight of Cobb broilers. According to the analysis of variance, the effect of PSP enrichment in poultry feed had no effect on the thigh weights of Cobb broiler chickens. PSP addition of poultry feed lead to thigh weight gain ranging from 15.23±0.86 to 15.99±0.24% based on broiler live body weight. The effect of PSP treatment in poultry feed on the carcass weights of Cobb chicken broiler revealed that the influence of PSP supplementation result in non-significant effects in Cobb broiler chick carcass weights. The addition of PSP to poultry feed resulted in carcass weight gain ranging from 61.54±1.02 to 62.47±0.98% based on broiler live body weight.

Moisture, Ash and pH

The effect of PSP enrichment in Cobb hen feed on the ash content (AC), moisture and pH in white meat was evaluated using ANOVA and results for mean are shown in figure 3. The effect of (PSP) fortified meal on the ash content (AC) of Cobb broiler breast meat was examined. In this investigation, ANOVA of AC of broiler flesh revealed that PSP treatments had no effect on the AC of chicken meat. The average AC of the breast red meat samples studied in this study ranged from 1.65±0.11 to 1.35±0.18 derived from chicken feed on a basal go on a diet enriched with PSP. The findings of this analysis opposed those of Jankar et al. (2018). Cobb broiler chicken flesh ash content after PSP addition in poultry feed induces a non-significant outcome on the. The effect of (PSP) enriched diet on the moisture content (MC) of Cobb broiler breast meat yielded a non-significant result. The MC of samples of breast meat ranged from 73.79±0.70 to 71.15±1.63. Sharma et al. (2017) discovered that pomegranate addition in poultry diet had no effect on MC. The effect of PSP-enriched feed on the pH of Cobb broiler breast meat has long been researched. The pH of the chick flesh differs insignificantly between pomegranate treatments. The pH of living mammalian tissues is 7.2 (Natalello *et al.*, 2022). In the absence of oxygen, cellular glucose is converted to pyruvic acid, which is then converted to lactic acid, lowering tissue pH (Duran *et al.*, 2016). Rigour mortis develops when the pH of chicken flesh falls between 5.4 and 5.8. muscular stiffens as muscular fibres contract during rigour mortis, reducing their ability to hold moisture (Zhang *et al.*, 2022). Lactic acid, degrades into ethanol, aldehydes, ketones, and carbon dioxide (CO_2), elevating the pH to 6-6.2. Rigour mortis dissolves, causing the muscle to relax. The pH of breast meat was tested after 60 min, which was the time it took for the pH to decline before rigour mortis set in. The pH of breast meat was tested after 30 min, which was the time it took for the pH to decline before rigour mortis set in. The current study's findings were consistent with those of Jankar et al. (2018), who discovered that organic pomegranate-enriched chicken feed increased performance.

Figure 3

Mean for Ash (A), Moisture (B) and pH (C) in Cobb broilers after pomegranate seed powder addition in chicken feed PSP0 expresses control diet, while PSP1, PSP2, PSP3 represents broilers fed diet supplemented with 0%, 0.5%, 1%, and 1.5% pomegranate seed powder. The results are not significantly different from each other (p>0.05%)



Instrumental Color

Table 3 displays the ANOVA results for the lightness (L*) criteria for Cobb broiler breast chicken. According to the ANOVA results, dietary PSP enrichment had no effect. Dispensation has an effect on the lightness of Cobb broiler chicken generated by broiler birds feed PSP enhances hen feed. The current L* values of bright chicken were comparable to those reported by Sharma et al. (2017) who supplemented the hen diet with pomegranate. The effect of pomegranate in chicken feed on the L* values of Cobb broiler breast chicken, on the other hand, was not significant. The table shows the redness (a*) values of breast chicken produced by PSP fed Cobb broiler. The effect of processing elements such as heat, refrigeration, density, and bright (unprocessed) chicken on Cobb broiler redness (a*). PSP supplementation in broiler feed interaction was also non-significant in this study. The colour of meat is determined by myoglobin, a sarcoplasmic protein. Fresh meat's colour is an excellent indication of its quality.

Table 3

Instrumental colour analysis of Cobb broiler after PSP enrichment

		Raw	Cooked	Compressed
Redness	PSP0	14.7±0.66bc	2.4±0.30d	12.53±0.5c
	PSP1	19.17±0.76a	2.83±0.42d	11.7±0.75c
	PSP2	12.6±0.62c	2.4±0.36d	12.27±0.83c
	PSP3	16.67±3.21ab	2.97±0.15d	13.57±1.48bc
Yellownes	PSP0	34.4±0.53a	10.23±0.9d	22.53±2.5c
	PSP1	36±10a	10.43±0.49d	28.67±3.06b
	PSP2	35.33±1.53a	6.9±0.95d	23.17±1.04c
	PSP3	33.03±0.95ab	7.97±0.55d	21.4±2.95c
Lightness	PSP0	59.5±0.5f	68.9±1.44ab	61.07±0.95def
	PSP1	54.63±1.1g	70.43±1.33a	61.87±0.81de
	PSP2	59.83±0.57ef	64.43±1.81c	62.33±1.04d
	PSP3	59.07±1.01f	68.03±2.12b	60.87±1.03def

PSP= pomegranate seed powder, PSP0, PSP1, PSP2 and PSP3= doses at 0,0.5,1 and 1.5 % PSP in the basal diet. Different letters depict the significant difference in results (p<0.05, n=40).

Myoglobin is oxidised and converted into dark metmyoglobin. According to the findings of this study, incorporating pomegranate to chicken diet had no effect on the redness of young chicken breast tissue. As a result, the results agreed with those of Sharma et al. (2017). The yellowness (b*) readings for breast chicken of pomegranate-fed Cobb broilers were investigated where heat, refrigeration, compression, alongside fresh meat had no effect on the b* values of the breast flesh (non-significant) and the results agreed with those of (Sharma et al., 2017).

Organoleptic Evaluation

The ANOVA results demonstrate that the organoleptic hardness values for breast meat samples collected from broilers fed a PSP-supplemented diet were non-significant (p>0.05). The highest hardness value (7.47±0.15) was found in PSP2 for cooked meat samples, while the lowest value (5.93±0.15) was found in PSP0 for raw meat samples. The influence of PSP fortification in chicken feed on the springiness of flesh obtained from the breast region of broilers was examined, and the results for organoleptic springiness values were non-significant (p>0.05). However, the impact of heat processing on springiness was significant (p<0.05). The PSP Treatment*Thermal Processing connection, on the other hand, was not significant. PSP enrichment in the chicken feed varied the springiness of meat samples from 6.98±0.4 to 7.10±0.3. The springiness of raw meat samples (7.50±0.3) was considerably (p<0.05) greater than that of cooked meat samples (6.60±0.3). The maximum value of springiness (7.6±0.36) was recorded in PSP2 of raw meat samples, while the lowest value (6.57±0.32) was observed in PSP1 of raw cooked samples. For the organoleptic juiciness values, samples taken from broilers fed a diet supplemented with PSP yielded non-significant (p>0.05) results. However, the effect of thermal processing on juiciness was substantial (p<0.05). The PSP Treatment*Thermal Processing connection, on the other hand, was not significant. The effects of PSP supplementation in the chicken feed on meat juiciness ranged from 6.980.2 to 7.070.3. The raw beef (7.58±0.2) samples were substantially (p<0.05) juicier than the cooked meat (6.52±0.2) samples. The highest juiciness value (7.9±0.1) was found in PSP1 of raw meat specimens, while the lowest (6.47±0.15) was found in PSP0 of cooked meat sample. The free moisture substance naturally present in raw meat is linked to its juiciness (Mahdikhani and Davoodi, 2007). Unlike Sharma et al. (2017), the current investigation discovered no significant effect of pomegranate addition in the basal fast on the juiciness of uncooked broiler breast flesh. The organoleptic taste and values of breast meat samples collected from broilers fed a diet enriched with PSP were non-significant (p>0.05). However, the thermal processing had a substantial (p<0.05) effect on the texture findings. The PSP Treatment*Thermal Processing connection, on the other hand, was not significant. The effects of PSP enrichment in the chicken feed on meat texture ranged from 7.12±0.2 to 7.22±0.2. The texture of raw beef (7.45±0.3) samples was considerably (p<0.05) higher than that of cooked meat (6.9±0.3) samples. The highest texture value (7.53±0.31) was found in PSP1 of raw meat samples, while the lowest (6.83±0.35) was found in PSP0 of cooked meat samples. The effects of PSP supplementation in the chicken diet on meat taste ranged from 7.47±0.4 to 7.67±0.3. The aroma values of breast meat samples produced from broilers fed by PSP-supplemented diet were non-significant ($p>0.05$). However, the thermal processing had a substantial ($p<0.05$) effect on the fragrance outcomes. The PSP Treatment*Thermal Processing connection, on the other hand, was not significant. The aroma of meat samples ranged from 6.950.1 to 7.17±0.3 after PSP enrichment in the chicken diet. The scent of cooked meat samples (8.06±0.2) was substantially ($p<0.05$) larger compared to that of raw meat samples (6.16±0.2). The maximum aroma value (8.2±0.26) was found in PSP2 of cooked meat samples, while the lowest (5.93±0.06) was found in PSP0 of raw meat samples. The appearance results of breast meat samples collected from broilers fed a PSP-supplemented diet were non-significant ($p>0.05$). However, the effect of the thermal processing was significant ($p<0.05$) on the appearance results. On the other hand, the PSP Treatment*Thermal Processing interaction was non-significant. The results of PSP enrichment in the chicken diet on the appearance of meat samples varied from 6.87±0.3 to 7.13±0.2. The appearance of the raw meat (7.34±0.3) samples was significantly ($p<0.05$) greater than that of cooked meat (6.66±0.1) samples. The highest value (7.53±0.31a) of appearance was observed in PSP3 of cooked meat samples, whereas the lowest value (6.57±0.15c) was seen in PSP2 of cooked meat samples.

Table 4

Organoleptic evaluation of Cobb broiler after PSP enrichment

		Raw	Cooked
Hardness	**PSP0**	7.5±0.2ab	6.47±0.15c
	PSP1	7.9±0.1a	6.57±0.32c
	PSP2	7.33±0.31b	6.53±0.15c
	PSP3	7.6±0.44ab	6.53±0.21c
Juiceness	**PSP0**	7.5±0.2ab	6.47±0.15c
	PSP1	7.9±0.1a	6.57±0.32c
	PSP2	7.33±0.31b	6.53±0.15c
	PSP3	7.6±0.44ab	6.53±0.21c
Springness	**PSP0**	7.4±0.46a	6.57±0.35b
	PSP1	7.53±0.35a	6.57±0.32b
	PSP2	7.6±0.36a	6.6±0.36b
	PSP3	7.5±0.4a	6.7±0.3b
Texture	**PSP0**	7.4±0.3ab	6.83±0.35c
	PSP1	7.53±0.31a	7.1±0.26abc
	PSP2	7.4±0.3ab	7.1±0.26abc
	PSP3	7.5±0.36a	6.93±0.35bc
Aroma	**PSP0**	5.93±0.06b	7.97±0.21a
	PSP1	6.2±0.26b	8.07±0.15a
	PSP2	6.23±0.25b	8.2±0.26a
	PSP3	6.3±0.36b	8.03±0.25a
Appearance	**PSP0**	7.17±0.31ab	6.57±0.31c
	PSP1	7.43±0.47a	6.8±0.1bc
	PSP2	7.23±0.31ab	6.57±0.15c
	PSP3	7.53±0.31a	6.73±0.21bc

SP= pomegranate seed powder, PSP0, PSP1, PSP2, and PSP3= doses at 0,0.5,1 and 1.5 % PSP in the basal diet. Different letters depict the significant difference in results ($p<0.05$, n=40).

CONCLUSION

The high utilization of pomegranate juice leads to the massive production of wastes shaped by the juice industry, which includes pomegranate peel and seeds. Using pomegranate waste powder in chicken feed and analyzing its impact on chicken growth, meat processing quality, and sensory qualities, the current study sought to control fruit waste. Dietary pomegranate waste was considered a crucial tool for waste management and to improve the development characteristics and meat quality of broilers.Conclusively, using pomegranate waste in chicken feed lowered the environmental load without compromising development outcomes, organ weights, or meat quality.

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