



Effects of Dried Tomato Pomace Dietary Supplementation on Production Performance, Egg Quality and Carotene Content in laying hens: A Narrative Review

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ABSTRACT

Tomato pomace is a rich source of protein, fiber, carbohydrates, and carotenoids for layer hens. Adding a moderate level of dried tomato pomace to laying hen diets is considered safe and has no adverse effects on performance metrics such as egg production, feed intake, egg weight, or shell thickness. The present study aimed to evaluate the effects of nutritional supplementation with dried tomato pomace on the productivity, egg quality, and carotene content of laying hens. A narrative literature search was conducted using scientific databases, including Scopus, PubMed, and Web of Science. The search primarily focused on peer-reviewed studies published from 2019 to 2026. Relevant previous studies were included to provide important background and context for the current study. Although tomatoes are rich in nutrients, such as carotenoids, fiber, vitamins, and bioactive compounds, processing industries often discard tomato pomace as waste. Improper disposal of tomato waste also poses environmental issues. Due to its nutritional content, dried tomato pomace could serve as a dietary supplement for chickens, especially in laying hens, where dietary carotenoids can influence egg yolk coloration and nutritional quality. Dietary tomato pomace, a useful delivery system for improving human health, positively affected lycopene deposition in egg yolk. Dried tomato pomace can be added to laying hens' diets at up to 5-12% (50-120 g/kg feed) to improve egg yolk color and carotenoid content without adversely affecting laying hens' productivity, while also lowering production costs and egg cholesterol content. Including dried tomato pomace at levels up to 12% (120 g/kg feed) can improve egg nutrition by increasing natural antioxidants such as lycopene and β -carotene, making it an economical and sustainable feed supplement for poultry.

Keywords: Carotene, Egg quality, Laying hen, Production performance, Tomato pomace

INTRODUCTION

Utilizing agro-industrial byproducts offers an alternative approach to addressing the shortage and rising cost of conventional feed in poultry nutrition (Georganas et al., 2023). Dried tomato pomace is a nutritionally valuable non-conventional feed ingredient that can be incorporated into laying-hen diets without adversely affecting key laying performance parameters, while improving yolk pigmentation (Mierlita et al., 2024). In commercial poultry production, feed costs represent a major component of total production costs, accounting for more than 60% of total costs (Noblet et al., 2022). Therefore, least-cost feed formulation and the use of alternative feed ingredients have received considerable attention as strategies for minimizing feed costs and improving the profitability of poultry production (Alhotan, 2021). The nutritional value of the substitute feed should allow partial replacement of conventional ingredients without adversely affecting productivity or immunity (Sultana et al., 2016).

In laying hens, molting is a normal physiological process that involves the replacement and shedding of old feathers (Glatz and Tilbrook, 2021). Egg laying is significantly reduced or stops during molting because the reproductive tract regresses and then regenerates, temporarily suppressing reproductive activity (Glatz and Tilbrook, 2021). Recent studies on fasting-induced molting in laying hens have indicated significant alterations in egg quality, production performance, and reproductive function (Ma et al., 2025). Mansoori et al. (2007) found that DTP successfully triggered molting and a decrease in ovarian weight, and hens that experienced molting induced by DTP demonstrated greater egg production after molting compared to hens that were subjected to feed withdrawal. Studies evaluating dried tomato pomace and tomato waste as dietary ingredients have generally reported no adverse effects on major laying-performance parameters, including feed intake, egg production, feed conversion ratio, egg weight, and egg mass (Salajegheh et al., 2012; Mahata et al., 2020). Additionally, DTP had no notable effects on several egg-quality parameters, including eggshell weight,

eggshell thickness, and Haugh unit. However, DTP inclusion significantly increased the yolk color score (Salajegheh et al., 2012).

Laying hens fed diets with DTP may consume more feed due to the feed's palatability and the presence of bioactive substances including antioxidants such as ascorbic acid and carotenoids (Mierlita et al., 2024). However, because tomato pomace contains large amounts of dietary fiber, excessive supplementation may reduce feed intake by increasing intestinal fullness and bulk density; therefore, the response depends on the level of dietary inclusion (Reda et al., 2022). Lycopene, β -carotene, lutein, and other carotenoids are present in tomato pomace, which laying hens consume and incorporate into the egg yolk (Reda et al., 2022). By lowering lipid oxidation and raising provitamin A activity, the deposition of dietary carotenoids, especially lycopene, improves egg yolk coloring (a deeper yellow to orange hue), increases the yolk's carotenoid concentration and antioxidant capacity, and increases the yolk's nutritional value for consumers (Reda et al., 2022). Dried tomato pomace contains substantial levels of crude protein (15-30 g/100 g), crude fat (8-24 g/100 g of dry weight), and dietary fiber (11-66 g/100 g of dry weight, dry matter basis; Chabi et al., 2024). However, DTP composition differs with tomato type and processing conditions. Because of its nutritional value, DTP is a suitable agro-industrial by-product for partially replacing conventional feed ingredients in chicken diets (Chabi et al., 2024). Tomatoes are among the most widely produced agricultural products worldwide. Asia accounts for 62.6% of the world's 186 million tons of tomatoes, followed by the Americas (13.1%), Europe (12.2%), Africa (11.9%), and Oceania (0.2%; FAOSTAT, 2022). Juices, sauces, and canned fruits are among the processed goods that frequently use tomatoes as a raw ingredient. Due to overproduction of fresh tomatoes or processing losses, the tomato production and processing sectors generate industrial waste (Laranjeira et al., 2022).

The tomato (*Solanum lycopersicum*) is one of the most widely produced vegetable crops in Mediterranean countries. After juice extraction, tomato pomace, primarily composed of water, tomato seeds, and peels, remains (Lu et al., 2019). The high-water content of tomato pomace limits its shelf life. Because of these storage limitations, tomato pomace is often dried (Salajegheh et al., 2012). Tomato pomace has significant nutritional value, containing up to 16 g/100g of crude protein due to its diverse bioactive constituents, including vitamins, polyphenols, minerals, and carotenoids (Azabou et al., 2020). Additionally, lycopene constitutes 80-90 g/100 g dry weight of the total carotenoid content in tomato pomace (Nour et al., 2018).

Tomato pomace is rich in essential amino acids, fatty acids, flavonoids, carotenoids, and certain minerals including calcium, copper, manganese, zinc, and selenium (Azabou et al., 2020). The effects of tomato pomace on digestive enzymes, reproductive and productive capacity, and the deposition of carotenoids in laying hen egg yolks are not well understood. Tomato processing industries generate large quantities of waste pomace, which is often discarded despite being rich in nutrients such as carotenoids, fiber, vitamins, and bioactive compounds. The improper disposal of tomato waste can pose environmental risks. Considering its nutritional profile, dried tomato waste pomace could serve as a dietary supplement in poultry nutrition, particularly in laying hens, since dietary carotenoids can affect egg yolk color and nutritional value (Georganas et al., 2023). Nevertheless, the optimal inclusion levels and overall impacts of DTP on laying hen performance, egg quality, and egg carotenoid content remain largely undetermined (Georganas et al., 2023). Therefore, the present study aimed to examine the effects of dietary DTP supplementation on production performance, egg quality, and egg carotenoid content in laying hens.

SEARCH CRITERIA

The literature search strategy for this narrative review used major scientific databases, including PubMed, Scopus, and Web of Science. The evaluation focused primarily on peer-reviewed articles published between 2019 and 2026. Relevant previous studies were included as needed to provide important background and context for the current study. Search queries combined keywords such as laying hens, dried tomato pomace, production performance, egg quality, and egg yolk carotenoids. The review included 20 studies identified from scientific databases, including Scopus, PubMed, and Web of Science. Studies were eligible for inclusion when they were peer-reviewed, involved laying hens, and reported original experimental data on the effects of dietary supplementation with DTP on production performance, egg quality, or egg carotenoid content. Studies were excluded when they involved poultry species other than laying hens, did not investigate DTP supplementation, or did not report outcomes related to production performance, egg quality, or carotenoid content. The identified studies were screened based on their titles and abstracts, followed by full-text assessment of potentially eligible articles. Relevant information from the included studies was extracted and synthesized narratively according to the objectives of the review.

CHEMICAL COMPOSITION OF TOMATO POMACE

Del Valle et al. (2006) reported that tomato pomace typically contains 56 g/100 g of dry weight in pulp and peels, with seeds constituting 44 g/100 g. However, tomato pomace composition depends on the final product and the peeling

techniques used during production (Eslami et al., 2023). Tomato pomace is rich in valuable components, including lycopene, proteins, lipids, and dietary fiber (Table 1). More specifically, tomato pomace primarily consists of fiber (39.11-59.03 g per 100 g of dry weight), fats (2-16.24 g per 100 g of dry weight), and proteins (15.08-24.67 g per 100 g of dry weight). These variations depend on factors such as tomato variety, growth stage, ripening process, processing methods, extraction conditions, and analytical techniques used (Lu et al., 2019).

The proximate chemical composition of tomato pomace collected at different stages of industrial processing, on a dry-weight basis, consisted of 59.03 g/100 g neutral detergent fiber (fiber), 25.73 g/100 g of total sugars, 19.27 g/100 g of protein, 7.55 g/100 g of pectin, 5.85 g/100 g of lipids, and 3.92 g/100 g of minerals (Del Valle et al., 2006). Dried tomato wastes have high levels of lycopene (0.05106 g/100 g) and β -carotene (0.00956 g/100 g of dry weight) and substantial antioxidant properties, according to Nour et al. (2018).

The chemical composition of tomato pomace differs considerably across the studies (Lu et al., 2022; Chabi et al., 2024). The wide variation in reported protein, oil, and fiber contents in tomato pomace mainly results from differences in seed-to-skin ratio and processing techniques (Lu et al., 2022). Tomato pomace is a diverse by-product made largely of skins, seeds, and leftover pulp, with the proportions of these components fluctuating with tomato variety and industrial processing conditions (Lu et al., 2022; Chabi et al., 2024). Pomace with a higher seed percentage typically has higher protein and fat levels, as tomato seeds are naturally rich in both nutrients (Lu et al., 2022). Conversely, pomace with a higher skin percentage typically has higher fiber content (Lu et al., 2022; Chabi et al., 2024). Furthermore, the final composition can be significantly impacted by variations in processing and separation techniques, such as pressing, drying, milling, and pulp or seed removal (Chabi et al., 2024). Therefore, instead of indicating inherent inconsistencies among the studies, the reported ranges in proximate composition, especially for crude protein, crude fiber, ether extract, and ash, should be regarded as indicative of variations in raw material composition and processing conditions (Lu et al., 2022).

Table 1. Chemical composition of tomato pomace

Material	Fibres (g/100 g of DW)	Proteins (g/100 g of DW)	Fat (g/100 g of DW)	Lycopene (g/100 g of DW)	Reference
Pomace	39.11-59.03	15.08-24.67	2.00-16.24	9.82-611.105	Savadkoobi and Farahnaky (2012); Shao et al. (2013)
Peels	62.79-78.56	1.85-11.13	1.63-5.50	50-1930	Grassino et al. (2016); Wang et al. (2016); Nour et al. (2018)
Seeds	16.00	20.2-40.94	17.80-24.50	22.01-37.43	Mechmeche et al. (2017); Szabo et al. (2021)

DW: Dry weight, Source: Eslami et al. (2023)

EFFECTS OF TOMATO POMACE ON LAYING HENS' PERFORMANCE

The increases in hen-day egg production and egg mass may be attributed to the high crude fiber content and nutritional value of tomato waste (Handayani et al., 2023). However, depending on the specific tomato variety and processing method, DTP exhibited substantial levels of dietary fiber, approximately 11-66 g per 100 g on a dry matter basis (Chabi et al., 2024). While dietary fiber contributes nutritional value to tomato pomace, excessive dietary fiber levels may reduce nutrient digestibility and utilization in poultry (Jha and Mishra, 2021). Crude fiber levels were reported as 52.44 g/100 g of dry weight in tomato peels and seeds (Nour et al., 2018), 40.43 g/kg in tomato peels (Varzaru et al., 2021), and 35 g/100 g of dry weight in tomato pulp (Jafari et al., 2006).

Fiber affects anatomical, functional, and physiological changes in the gastrointestinal tract (Deehan et al., 2022). Dietary fiber affects intestinal microbiota, gastrointestinal tract development, egg quality, laying performance, and nutritional digestibility (Desbruslais et al., 2021). When laying hens were fed tomato waste at 7.1 g/100 g of dry weight or 8.6 g/100 g of dry weight, the maximum dietary fiber content was increased (Handayani et al., 2023). Chickens' carcasses demonstrated undigested feed components and nutritional deficiencies attributable to excessive dietary fiber intake (Jha and Mishra, 2021). As a result, egg yield and egg mass weight were expected to decrease (Handayani et al., 2023). According to Yannakopoulos et al. (1992), laying hens fed diets containing up to 15 g/100 g of dry weight tomato pomace for 8 weeks did not produce more eggs than chickens fed a control diet. Jafari et al. (2006) reported that egg mass and production increased in laying hens when fed up to 10 g/100 g of dry weight of DTP for 12 weeks.

In a study by Mierlita et al. (2024), laying hens were fed diets supplemented with 4% DTP and 20% hempseed cake for 10 weeks (70 days), which increased feed intake and improved the antioxidant content and oxidative stability of egg yolk. However, chickens fed the diet comprising 4% DTP and 20% hempseed cake exhibited a body weight gain of 97.5

g, whereas the control group demonstrated a gain of 116.4 g. This result showed that incorporating 4% DTP and 20% hempseed cake into the diets of laying hens did not adversely affect their weight gain, indicating that these components can be included without hindering the growth performance of the hens. Additionally, [Yannakopoulos et al. \(1992\)](#) reported that body weight gain, feed consumption, and overall performance metrics of laying hens were not significantly affected by the dietary inclusion of tomato meal. In laying hens under normal environmental conditions, dietary inclusion of DTP at levels up to 19 g/100 g of dry weight for 10 weeks produced no adverse or appreciable effects on overall performance parameters, including egg production, body weight, feed intake, feed conversion ratio, and egg weight traits ([Salajegheh et al., 2012](#)). [Alagawany et al. \(2022\)](#) reported that dietary supplementation with 3-12 g/100 g of dry weight sun-DTP for 28 days (from 1 to 5 weeks of age) improved body weight and body weight gain in growing Japanese quail, with the 6 g/100 g of dry weight inclusion level producing the greatest improvement. Similarly, [Muhammad et al. \(2025\)](#) reported that dietary supplementation with dried tomato pomace at 10 and 20 g/kg (1% and 2%) for 35 days improved growth performance, including body weight gain and feed conversion ratio, in Ross 308 broiler chicks exposed to heat stress.

[Akyol and Denli \(2023\)](#) conducted a 9-week feeding trial in laying hens and reported that dietary inclusion of 4% dried tomato pulp increased feed consumption, egg production, and egg weight compared with the control group. [Salajegheh et al. \(2012\)](#) reported that dietary supplementation with dried tomato pomace (DTP) at 150, 170, and 190 g/kg diet (15%, 17%, and 19%, respectively) for 10 weeks did not significantly affect average feed intake of Lohmann LSL-Lite laying hens compared with the control group. [Tufarelli et al. \(2022\)](#) evaluated the effects of diets with 15 g/100 g dry weight DTP on laying hens over 8 weeks and indicated that incorporating DTP into the diet did not negatively affect productive performance, egg production, egg weight, or feed conversion ratio. Previous studies have indicated that dietary inclusion of dried tomato pomace (DTP) at 5-10 g/100 g of the diet did not negatively affect feed intake in laying hens, suggesting good dietary acceptance. [Jafari et al. \(2006\)](#) reported similar feed consumption at DTP inclusion levels of 5% and 10% over a 12-week feeding period, while [Mansoori et al. \(2008\)](#) observed no significant effect on feed intake at 5% and 10% DTP inclusion over 9 weeks. [Handayani et al. \(2023\)](#) reported that integrating tomato waste into laying hen diets increased feed consumption and appeared to have a quadratic relationship with egg mass and daily egg production per hen, although the eggshell strength decreased significantly.

EGG QUALITY

In a meta-analysis of 22 studies involving laying hens, [Handayani et al. \(2023\)](#) reported that dietary tomato waste inclusion levels ranging from 0 to 20 g/100 g of dry weight of the diet improved yolk color, which was primarily attributed to the lycopene and other carotenoid pigments present in tomato waste. In addition, tomato-waste supplementation significantly reduced overall eggshell strength, suggesting that adverse effects on shell integrity may occur under some dietary conditions ([Handayani et al., 2023](#)). Lycopene, the red pigment found in fruits, vegetables, and other plant components, is one of the carotenoid molecules generated by plants ([Cooperstone et al., 2016; Reboul, 2019](#)). Dietary carotenoids have been indicated to affect egg yolk color. Previous studies indicated that carotenoid compounds in laying hens' diets significantly altered the intensity of their egg yolk color ([Rakonjac et al., 2014; Kaspers, 2016](#)). [Calislar and Uygur \(2010\)](#) reported that dried tomato pulp can be included in laying hen diets at levels up to 2 g/100 g of diet, improving egg yolk color without adversely affecting egg production. Similarly, [Salajegheh et al. \(2012\)](#) reported that dietary inclusion of DTP at 15 g/100 g, 17 g/100 g, and 19 g/100 g for 10 weeks (70 days) significantly improved egg yolk color without adversely affecting egg production, laying performance, or other egg quality traits. [Ahmed et al. \(2022\)](#) reported that the dietary inclusion of tomato waste meal at levels up to 26 g/100 g of diet for 84 days did not negatively impact laying performance or egg quality parameters, except for a notable enhancement in egg yolk color intensity. [Karadas et al. \(2006\)](#) found that adding 20 g/kg of tomato powder to adult Japanese quail diets for 23 days increased the egg yolk color score compared to a low-carotenoid control diet. Similarly, [Jafari et al. \(2006\)](#) observed that including dried tomato pulps at a level of up to 10 g/100 g of dry weight in the diet for 12 weeks enhanced egg production and egg mass in laying hens, without negatively impacting egg weight, eggshell weight, shell thickness, Haugh unit, or yolk color. [Tufarelli et al. \(2022\)](#) reported that dietary supplementation with 15 g/100 g of DTP combined with 5 g/100 g dried grape pomace for 8 weeks (56 days) significantly increased egg yolk color score, without adversely affecting egg production, egg weight, feed conversion ratio, or major egg quality traits in laying hens. In addition, [Yannakopoulos et al. \(1992\)](#) reported that diets containing 8 g/100 g or 15 g/100 g of tomato meal, fed to laying hens for 80 days (from 32 to 43 weeks of age), had no adverse effects on egg production or quality. [Akdemir et al. \(2012\)](#) indicated that dietary supplementation of laying hens with tomato powder at 0.5 g/100 g and 1 g/100 g for 90 days improved egg production persistency and increased egg yolk concentrations of carotenoids (lycopene, β -carotene, and lutein) and vitamin A. [An et al. \(2019\)](#) stated that supplementation of laying hen diets with synthetic lycopene (0.002 g/100 g diet) or tomato paste (1.7 g/100 g diet) for 4 weeks (28 days) affected laying performance and egg quality traits,

while increasing lycopene deposition in egg yolk and reducing lipid oxidation during egg storage. Moreover, higher amounts of DTP (up to 19 g/100 g) were included in the diets of laying hens for 8 weeks by [Salajegheh et al. \(2012\)](#), indicating no appreciable or significant impact on plasma total cholesterol, low-density lipoproteins, or egg yolk cholesterol content despite the substantial amount of tomato waste. Furthermore, tomato meal's high fiber content may limit its inclusion in poultry diets by reducing nutrient digestibility and utilization ([Leeson and Summers, 2001](#)).

[Leke et al. \(2015\)](#) indicated that dried tomato meal at inclusion levels up to 8 g/100 g for 8 weeks might be a beneficial alternative feed ingredient, since it did not negatively affect egg cholesterol content or egg quality. [Leke et al. \(2015\)](#) found no significant differences in egg nutrient or cholesterol content between the control diet and diets containing 2, 4, 6, or 8 g/100 g of dried tomato meal for 8 weeks. According to [Reda et al. \(2022\)](#), egg quality parameters, including albumen, yolk, and shell percentages, yolk index, Haugh unit, shell thickness, and egg shape index, were not affected by dietary tomato pomace inclusion up to 12 g/100 g for 8 weeks. Moreover, DTP at levels up to 12% enhanced lycopene deposition in egg yolk, suggesting its potential as a dietary strategy for producing lycopene-enriched eggs and promoting human health ([Reda et al., 2022](#)).

[Seidavi et al. \(2018\)](#) reported that when tomato pomace was incorporated at practical levels (typically 10 g/100 g to 19 g/100 g), no adverse or statistically significant changes in blood biochemical profiles, including serum total protein, albumin, and globulin levels, were observed. [Reda et al. \(2022\)](#) found that tomato pomace increased liver and kidney function by 6 g/100 g and 12 g/100 g, respectively. [Panaite et al. \(2019\)](#), in a 6-week feeding trial, found that dietary inclusion of dried tomato waste (2.5%, 5.0%, or 7.5%) in diets containing 5% flaxseed did not significantly affect egg weight. However, the 5.0% and 7.5% dried tomato waste treatments significantly reduced feed intake and laying percentage compared to the control. The effects of tomato by-products on eggshell quality appear to be inconsistent and may depend on inclusion level, by-product characteristics, and basal-diet composition (Table 2; [Handayani et al., 2023](#); [Mierlita et al., 2024](#)).

Table 2. Egg quality parameters in laying hens fed dried tomato pomace

Study	Material used	Inclusion level	Egg production	Egg color	Eggshell quality
Salajegheh et al. (2012)	DTP	0, 15, 17 and 19%	No significant effect	Significant increase in yolk color (7.25 to 9.67 RYCF units)	Shell thickness not affected
Tufarelli et al. (2022)	DTP	0 and 15% DTP $\pm$ 5% DGP	No significant effect	Highest with 15% DTP plus 5% DGP	Thickness and strength not affected
Mierlita et al. (2024)	DTP plus hempseed cake	4% DTP plus 20% hempseed cake	No significant effect	Increased (RYCF 6.67 to 9.26)	Thickness not significantly affected (0.362 to 0.364 mm)
Jafari et al. (2006)	Dried tomato pulp	0, 5, 10 and 15%	5-10% increased egg production and egg mass	No significant difference	Shell thickness (0.352, 0.361, 0.362 and 0.360 mm); no significant effect
Calislar and Uygur (2010)	Dried tomato pulp	0-20%	No significant effect on egg yield	Increased yolk pigmentation	Shell weight, thickness, and strength not affected
Yannakopoulos et al. (1992)	Tomato meal	8 and 15%	No significant adverse effect	Increased yolk color	No adverse effect on shell quality
Mansoori et al. (2008)	DTP	0, 5 and 10% (0, 50 and 100 g/kg)	No significant effect on egg production, egg weight, or egg mass	Significant increase in Roche yolk color score, from 6.7 in control to 9.7 and 10.3 at 5 and 10% DTP, respectively	No significant main effect on shell thickness or shell weight/egg weight ratio
Panaite et al. (2019)	Dried tomato waste (DTW) + 5% flaxseed	2.5, 5.0 and 7.5% DTW	Laying percentage significantly decreased in some DTW-supplemented groups; egg mass was not significantly affected	Yolk Roche color score increased with increasing DTW; the reported 7.5% DTW + 5% flaxseed treatment had a 3.5-fold higher score than control after 4 weeks	-

DGP: Dried grape pomace, DTP: Dried tomato pomace, RYCF: Roche yolk color Fan, mm: Millimeters, DTW: Dried tomato waste

CAROTENE CONTENTS OF EGG IN LAYING HENS

Dietary inclusion of dried tomato waste can increase carotenoid deposition in egg yolk, particularly lutein and zeaxanthin, and enhance yolk pigmentation in laying hens (Panaite et al., 2019). Several studies have demonstrated that laying hens fed diets containing tomato powder or tomato peel have higher yolk carotenoid contents (Akdemir et al., 2012; An et al., 2019). Akdemir et al. (2012) indicated that adding 0.5-1 g/100 g of dry weight of tomato powder to the diet for four weeks increased the quantities of lycopene and β -carotene in the yolk. Egg yolk coloration and antioxidant properties can be modified when laying hens consume diets supplemented with 4.5% linseed combined with 1% dried tomato paste and 1% sweet red pepper for 47 days (Omri et al., 2019). An efficient dietary method for improving the carotenoid profile and antioxidant status of egg yolks is to feed laying hens tomato pomace (Omri et al., 2019; Mierlita et al., 2024; Table 3). Nour et al. (2017) incorporated dried tomato waste for 6 weeks into the diet and observed an increase in total yolk carotenoids from 8.44 to 12.67 $\mu\text{g/g}$.

Dietary supplementation with DTP at 4 g/100 g of the diet for 10 weeks has been shown to improve yolk color intensity and increase the deposition of natural antioxidants and carotenoid-related compounds in laying hens (Mierlita et al., 2024). As an effective substitute for artificial pigments such as canthaxanthin and apocarotenoid acid ester, DTP offers a natural source of carotenoids that may support pigmentation (Yunitasari et al., 2023; Mierlita et al., 2024). Calislar and Uygur (2010) studied the impact of incorporating dry tomato pulp at rates up to 20 g/100 g for 8 weeks and found no negative effects on overall egg production, noting enhanced yolk coloration. More recently, a meta-analysis demonstrated that tomato-waste supplementation can affect laying performance and several egg-quality characteristics (egg weight, eggshell thickness, eggshell strength, eggshell weight, and yolk weight), although the magnitude and direction of responses differ by inclusion level and experimental conditions (Handayani et al., 2023).

Tomato-derived products and byproducts contain carotenoids, such as lycopene and other pigments (Nour et al., 2018). Incorporating tomato-derived products and byproducts into chicken diets can enhance egg yolk pigmentation and intensify yolk color (Nour et al., 2018; An et al., 2019). This improvement is highly valued by customers (Nour et al., 2018; An et al., 2019). Dried tomato pulp can be included in laying-hen diets at levels up to approximately 100 g/kg without negatively affecting laying-hen performance (Jafari et al., 2006). However, a higher inclusion level of 150 g/kg decreased egg production and egg mass, which may be associated with the relatively high fiber content of tomato pulp (Jafari et al., 2006).

The relatively high fiber content and nutrient composition of DTP should be considered when formulating poultry diets because DTP measurably affects nutrient digestibility and metabolizable energy utilization (Mansoori et al., 2008).

Table 3. Effects of tomato pomace on carotene contents of eggs in laying hens

Study	Tomato material	Inclusion level	Yolk color and carotenoid outcome
Salajegheh et al. (2012)	DTP	0, 15, 17 and 19%	Yolk color score significantly increased (7.25 to 9.67)
Tufarelli et al. (2022)	DTP	0 or 15% DTP, with 0/4/8% flaxseed meal and 0/5% dried grape pomace	Yolk color was highest with the 15% DTP + 5% DGP combination.
Mierlita et al. (2024)	DTP + hempseed cake	4% DTP + 20% hempseed cake	RYCF increased from 6.67 to 9.26
Akdemir et al. (2012)	Tomato powder	5 and 10 g/kg	Yolk color and yolk lycopene, β -carotene, lutein, and vitamin A increased.
Panaite et al. (2019)	Dried tomato waste + flaxseed	7.5% dried tomato waste + 5% flaxseed	Lutein and zeaxanthin increased by 29% and 24%, respectively; yolk Roche color increased 3.5-fold
Nour et al. (2017)	Dried tomato waste	7.5%	Total yolk carotenoids increased from 8.44 to 12.67 $\mu\text{g/g}$ and RYCF from 3.66 to 6.60 after six weeks.
Jafari et al. (2006)	DTP	0%, 5%, 10%, 15%	Significant linear increase in Roche yolk color Fan score as inclusion level increased, enhancing yolk pigmentation
Omri et al. (2019)	Dried tomato paste + sweet red pepper powder	1% dried tomato paste + 1% sweet red pepper, in a diet also containing 4.5% linseed	Significantly increased Roche yolk color fan score and yolk and increased yolk carotenoids
Calislar and Uygur (2010)	Dried tomato pulp	Up to 20%	Increased RYCF value and significantly increased yolk lycopene and β -carotene concentrations

DGP: Dried grape pomace, DTP: Dried tomato pomace, RYCF: Roche yolk color fan .

CONCLUSION

Dried tomato pomace is a promising agricultural by-product that contains nutrients and bioactive compounds, including carotenoids that may contribute to the nutritional value of laying-hen diets. Adding dried tomato pomace to laying hen diets improved egg yolk pigmentation and carotenoid content without negatively impacting productivity. Dietary inclusion of dried tomato pomace at levels up to approximately 12% (120 g/kg diet) has generally been reported to be safe for laying hens, without significant adverse effects on key performance parameters such as egg production, feed intake, egg weight, and shell thickness, although responses may vary depending on the composition and processing of the tomato pomace and the overall diet. Future studies should focus on finding the optimal level of dried tomato pomace inclusion for different laying hen breeds and production phases, as well as maximizing nutrient use and maintaining productivity. Additional studies are needed to identify effective strategies for reducing the negative effects of its high fiber content and improving nutrient digestibility.

DECLARATIONS

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Authors' contributions

Eyayu Gobe solely designed the review topic, conducted the comprehensive literature search, synthesized and critically analyzed the published data, and literature collection and organization and, contributed to reviewing and editing the manuscript for scientific accuracy and clarity, and provided intellectual input. The final edition of the manuscript was reviewed and approved by the author before publication in the present journal.

Availability of data and materials

The present study did not produce or analyze any new data. The literature reviewed in the current study is cited in the reference list.

Competing interests

The author has declared no competing interests.

Ethical considerations

The author affirmed that this article is original, has not been published previously, and is not under consideration for publication elsewhere. The author confirmed that no artificial intelligence (AI) or AI-assisted technologies were used in the preparation, drafting, or writing of this article. The author is responsible for the accuracy, originality, and integrity of the final content of the article before submission, during the revision process, and upon final publication. The author has carefully checked and verified all review data, interpretations, and conclusions of the present study and takes full responsibility for the intellectual and scientific content of the manuscript.

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