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**WINE GRAPE WASTE AS AN ALTERNATIVE SOLUTION FOR  
ALLEVIATING HEAT STRESS LAYING HENS' DIET  
A COMPREHENSIVE REVIEW**

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**Abstract:** Raw or fermented grape pomace, grape seed extract or grape seed oil were considered a dietary solution for laying hens nutrition due to their positive effects noticed in different trial inclusion levels especially when tested in heat stress conditions. The by-products as stems, skins, and seeds generated after harvest, constituting around 45% of total production, provide a cost-effective resource of valuable ingredients, particularly dietary fibers and natural antioxidant flavonoids, which provide significant biological benefits for animal. Different inclusion levels (ranging from 1% to 10%) were assessed laying hens' diets, under both normal and heat-stress conditions. The concentration of polyphenols is higher in seeds and stems compared to skins or leaves, though this can vary depending on factors such as winemaking process, soil/geographic conditions, and grape variety. Additionally, the antioxidant capacity can differ based on various analytical methods utilized. Heat stress environmental conditions compromises the antioxidant system, leading to the initiation of oxidative stress. Therefore, the grape by-products dietary inclusion could reduce the negative effects of heat stress, offers economic benefits for farmers and contributes to sustainable agricultural practices and the welfare of poultry production systems.

• **Introduction**

Grapes are a highly valuable crop produced in vineyards globally accessible for farmers' utilization. Statistically, FAO (Food and Agriculture Organization, 2015) suggested that grapes are the largest fruit crop worldwide. Rabiei et al., (2017) stated that grapes contains polyphenolic compounds (flavonoids, catechin, quercetin, stilbenes) with antioxidant, anti-inflammatory, antimicrobial properties. Heat stress, exacerbated by global warming, has significant negative impacts on poultry mortality and performance. This environmental stressor can lead to decreased feed intake, reduced egg production, and compromised overall health in poultry (Hu et al., 2019).

The study evaluated the benefits of incorporating various levels of grape pomace into the diets of laying hens. As a by-product rich in polyphenols, grape pomace can alleviate the effects of heat stress, improving poultry health and performance.

• **Material and method**

The literature exploration was reviewed using search engine such as Medline, PubMed, Web of Science, ScienceDirect, Scopus, and Google Scholar without time or language constraints. The keywords included were as follows: grape by-products, "grape pomace", "laying hens", "heat stress", "antioxidants", "polyphenols", "oxidative stress", "performances".

• **Conclusions**

Grape by-products are vital as feed alternatives in countries with extensive vineyards. Their utilization supports a circular agricultural economy by reducing waste and lowering feed costs for the poultry industry. Also, the polyphenols content of this biowaste can contribute to maintain poultry health and improve egg quality especially, in heat stress conditions.

• **Results and discussions**

Camponio et al. (2023) consider grape pomace the solid parts remaining after the crushing and pressing of grapes, including skins and seeds, with or without the stalks. The concentration of polyphenols is generally higher in grape seeds and stems compared to skins or leaves (Serra et al., 2023).

This concentration, however, can vary significantly based on several factors, including the winemaking process, soil and geographic conditions, and grape variety. The specific methods used to cultivate the grapes and the environmental conditions of the vineyard also play crucial roles in determining polyphenol content (Marques et al., 2023; Šikuten et al., 2020; Belda et al., 2017). These variations influence not only the antioxidant properties but also the overall nutritional value of grape by-products when used in animal feed. Consequently, understanding these factors is essential for optimizing the health benefits and efficacy of grape by-products in poultry diets, particularly under conditions of heat stress (Nardoia, 2016; Gálik et al., 2022).

Grape pomace flour - skins and seeds- (1%, 2% and 3%) enhanced productive efficiency and activating the antioxidant defense mechanism for when tested on laying hens in heat stress conditions (Reis et al., 2019). Grape seed extract (750 g/kg) improved egg production and decreased lipid peroxidation (25 to 32 °C) according to Hafeez et al., (2023). Kara et al., (2015) observed that 4% and 6% grape pomace reduced plasma and egg yolk MDA levels, as well as serum glucose levels.

Herranz et al., (2024) concluded that inclusion of 50 g/kg of grape pomace in hens' diet improved the internal quality of eggs but reduced shell thickness.



Grape pomace is an exceptionally rich source of polyphenols (60-70% remaining unextracted after wine processing)  
Polyphenols have antioxidant activity  
Inclusion levels (1% - 10%) in laying hens' diets under both normal and heat-stress conditions