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FUNCTIONAL PROPERTIES OF DRAGON FRUIT AND MULBERRY POWDER IN RESTRUCTURED PEKIN DUCK JERKY

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I. INTRODUCTION

The growing demand for clean-label, functional, and sustainable meat products has fueled innovation in meat processing. Consumers increasingly seek natural ingredients that enhance nutritional value and product quality while reducing reliance on synthetic additives. Dragon fruit (*Hylocereus spp.*) and mulberry (*Morus spp.*) are rich in bioactive compounds, including polyphenols, betalains, anthocyanins, flavonoids, and dietary fiber, all of which contribute to antioxidant activity and potential health benefits (Wen et al., 2019; Tripathi et al., 2024). In addition to their functional properties, these fruit powders provide natural pigmentation, which may enhance the visual appeal of meat products (Azmin et al., 2022). Restructured duck jerky offers a promising platform for incorporating such functional ingredients. However, oxidative degradation and color instability remain significant challenges in processed meat preservation. The addition of dragon fruit or mulberry powder may improve oxidative stability, enhance color retention, and influence consumer perception. This study aims to evaluate the effects of incorporating dragon fruit or mulberry powder on the physicochemical properties, oxidative stability, color retention, and sensory characteristics of restructured duck jerky. The findings may offer valuable insights into the potential of fruit-based additives in developing value-added meat products that align with evolving consumer preferences.

II. MATERIALS AND METHODS

Skinless, deboned leg muscles from 6-month-old Pekin ducks (N = 30) were ground using a 5 mm plate and assigned to four marinade treatments: CON (negative control, no nitrite/ascorbate), SN (control with 1.5% salt, 4% sugar, 0.6% soy sauce, 0.1% five-spice powder, 150 ppm sodium nitrite, and 500 ppm sodium ascorbate), and two treatments incorporating 1.5% (DF) dragon fruit or 1.5% (MB) mulberry powder. Freeze-dried red-flesh dragon fruit (*Hylocereus polyrhizus*) and mulberry (*Morus alba L.*) powder were purchased from a local food company. The restructured duck leg meat batters were mixed for 10 minutes at 15 rpm, held at 5°C for 24 hours, flattened to 8 mm thickness using parchment paper and a rolling pin, and thermally processed by drying at 55°C for 1.5 hours, 65°C for 0.5 hours, and roasting at 150°C for 10 minutes. Objective color (L*, a*, b*), TBARS, and sensory evaluation (Cropp et al., 2023) were assessed on the samples. This study was replicated three times. Treatments were compared by analysis of variance, using the GLM procedure. Mean values were compared using Tukey's test (SAS 9.3, SAS Institute, Inc., Cary, NC); P values lower than 0.05 were considered statistically significant.

III. RESULTS AND DISCUSSION

Table 1 indicates that treatments significantly influenced the color and lipid oxidation ($P < 0.05$). DF yielded the highest lightness (L*) value (31.65), likely due to its betalain content, consistent with findings by Tan et al. (2016), who reported that betalains enhance the color stability of meat products. Redness (a*) was highest in DF (13.63) and was associated with polyphenolic and betalain compounds that helped maintain meat color stability, similar to Papuc et al. (2017). Yellowness (b*) was highest in DF (7.48) and lowest in SN (5.92), possibly due to the extract interacting with myoglobin oxidation. For lipid oxidation, treated samples had significantly lower TBARS values than the control, with SN showing the strongest antioxidant effect (0.53 mg MDA/kg), followed by DF (0.95 mg MDA/kg) and MB (0.70 mg MDA/kg). These results align with Honikel (2008), who noted that sodium nitrite is effective in preventing lipid oxidation in meat products. Figure 1 summarizes the average sensory scores for color, texture, and flavor. SN scored highest for color (9.41) and flavor (9.27), showing minimal variability, while DF ranked second in both attributes, scoring 10.15 for color and 9.40 for flavor. DF excelled in texture (11.24), outperforming the other groups, which is consistent with Bellucci et al. (2021), who found that plant extracts, such as dragon fruit powder, can enhance the texture of meat products. CON consistently scored the lowest in all attributes, while MB showed stability in texture (9.43) but performed poorly in color (9.16) and flavor (8.27) compared to SN and DF.

Table 1. Effect of Different Treatments on Color Parameters and Lipid Oxidation in Restructured Duck Jerky

	Lightness	Redness	Yellowness	TBARS mg MDA/Kg
CON	26.55^{c}	10.28^{c}	7.23^{a}	1.29^{a}
SN	29.50^{ab}	12.47^{a}	5.92^{c}	0.53^{d}
MB	29.33^{ab}	11.65^{b}	6.45^{b}	0.70^{c}
DF	31.65^{a}	13.63^{a}	7.48^{a}	0.95^{b}
SEM	0.59	0.26	0.18	0.09
P value	< 0.05	< 0.05	< 0.05	< 0.05

$^{a-c}$ Means with different letters within a column differ significantly (P < 0.05).
SEM = Standard error of the mean

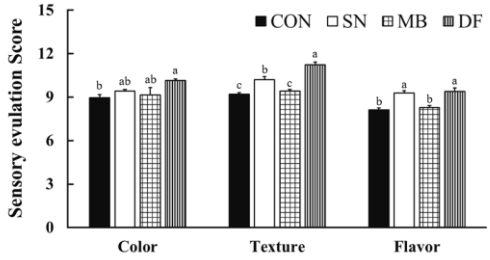


Figure 1. Sensory evaluation scores for color, texture, and flavor of restructured duck jerky treated with different ingredients. Treatments include CON (control, black bar), SN (sodium nitrite, white bar), MB (mulberry powder, checkered bar), and DF (dragon fruit peel powder, striped bar). $^{a-c}$ Means with different letters within the same indication differ significantly (P < 0.05). Restructured duck jerky evaluated on a 15-cm hedonic scale (1 = like the least, 15 = like the most). Bar = Standard Error.

IV. CONCLUSION

In restructured duck jerky, both dragon fruit and mulberry powders improved oxidative stability, color retention, and texture. Dragon fruit powder enhanced color, while mulberry powder contributed both pigmentation and antioxidant benefits. These findings support the rising demand for clean-label, sustainable meat products, aligning with trends for eco-friendly processing and improved product quality.

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