Screening of Formulation and Processing Variables Affecting Sensory Quality of Passion Fruit Albedo Fiber-Fortified Chicken Jerky: A Plackett-Burman Approach

*Joy G. Doron[1], Hershey P. Mondejar[2], Zandro Perez[3] and Anjin Pleiadess P. Cabrera[4]
[1]College of Agriculture, Food Science, Agribusiness and Development Communication,
Cebu Technological University – Barili Campus,
Cebu, Philippines, jjdoron25@gmail.com (Corresponding Author)
[2]College of Veterinary Medicine, Cebu Technological University – Barili Campus,
Cebu, Philippines, Hershey.mondejar@gws.ctu.edu.ph
[3]College of Agriculture, Food Science, Agribusiness and Development Communication,
Cebu Technological University – Barili Campus,
Cebu, Philippines, anjinpleiadesscabrera@gmail.com

Abstract— This study screened seven formulation and processing variables passion fruit albedo fiber (PFAF) form (g), salt (g), nitrite (g), drying temperature, drying time, marination technique, and slicing thickness for their effects on the sensory quality of culled Rhode Island Red (RIR) chicken jerky, using a seven variable, eight-run Plackett-Burman design (PBD). Thirty untrained panelists rated color, texture, taste, aroma, spiciness, chewiness, juiciness, springiness, saltiness, and overall acceptability on a 9-point hedonic scale for each of the eight treatment combinations. Estimated effects were computed for each factor and visualized using Pareto charts at $\alpha = 0.05$. Salt concentration was the most influential variable, registering significant effects across all ten sensory attributes evaluated. Marination technique was the second most influential factor, significantly affecting texture, taste, spiciness, springiness, saltiness, and overall acceptability, while nitrite concentration significantly affected color, saltiness, and overall acceptability. PFAF form significantly affected texture only. Drying temperature, drying time, and slicing thickness did not significantly affect overall acceptability within the levels screened. Because response surface methodology (RSM) requires continuous, quantitatively adjustable factors, salt concentration, nitrite concentration, and PFAF concentration were carried forward for optimization by central composite design, while marination technique was fixed at the manual method for practical and scalability reasons, and drying temperature, drying time, and slicing thickness were fixed at their better-performing screening levels. These findings provide an evidence-based, resource-efficient basis for narrowing a seven-factor formulation and processing space into a three-factor optimization space for further development of PFAF-fortified culled chicken jerky.

Keywords: **Plackett-Burman design, screening design, chicken jerky, passion fruit albedo fiber, sensory evaluation, dietary fiber fortification.**

1. INTRODUCTION

Jerky is among the oldest forms of preserved meat, produced by salting and drying to reduce water activity to levels that inhibit microbial growth while extending shelf life without refrigeration. Its light weight, nutrient density, and ambient stability make it a popular snack among consumers seeking convenient, protein-dense foods. As an intermediate-moisture meat product, jerky quality depends on the interaction of multiple formulation and processing factors salt and curing agent levels, drying temperature and time, marination method, and cut thickness all of which jointly determine the final texture, color, flavor, and overall consumer acceptability of the product.

Culled layer chickens, such as spent Rhode Island Red (RIR) hens removed from egg-laying flocks after their productive period, represent an underutilized protein resource [5]. Their meat is comparatively tougher and less palatable than that of commercial broilers, which limits direct consumer acceptance but makes it a suitable candidate for restructured and dried products such as jerky, where processing can be used to manage textural limitations while adding value to a by-product of the poultry industry [6].

Passion fruit (Passiflora edulis var. flavicarpa) processing generates substantial volumes of peel as a co-product, the principal component of which is the albedo a white, spongy, cellulosic tissue rich in dietary fiber. Passion fruit albedo fiber (PFAF) has been characterized as a source of high total dietary fiber with high water-holding capacity (13.00

g/g), high swelling capacity (37.00 mL/g), and moderate oil-holding capacity (2.03 g/g), together with notable anti-oxidant activity and minimal impact on product color [1]. These functional properties have supported its use as a fiber-fortification ingredient in meat systems, including pork burgers and chicken sausages, where it improved water- and fat-binding behavior without adversely affecting product acceptability [1]. More broadly, fruit- and vegetable-derived dietary fibers have gained renewed attention as functional meat ingredients in recent reviews, which highlight their hydration, water-binding, and technological properties across a range of processed meat matrices [7], [8]. However, existing work on PFAF as a meat-system ingredient has focused on wet, comminuted products such as burgers and sausages [1], and no published study has examined its incorporation into a dried, restructured jerky matrix, where the combined effects of formulation ingredients and drying-related processing parameters on sensory quality have not been jointly characterized. Incorporating PFAF into RIR chicken jerky is therefore a promising strategy for simultaneously valorizing an agricultural by-product, improving the nutritional profile of a value-added meat product, and diversifying the fiber-rich functional food category.

Because jerky quality depends on the joint action of several formulation and processing variables, the eventual optimization of a PFAF-fortified jerky formulation requires first identifying which of these variables meaningfully influence sensory acceptability before committing resources to a full response surface study. A Plackett-Burman design (PBD) is well suited to this purpose: it allows several factors to be screened simultaneously using a comparatively small number of experimental runs, efficiently separating statistically significant factors from non-significant ones and thereby reducing the experimental burden of the subsequent optimization phase. This screening-then-optimization strategy has been successfully applied in other food formulation contexts, where PBD was used to identify the most influential formulation and process variables prior to detailed optimization [9].

This study therefore applied a seven-variable, eight-run PBD to screen the effects of PFAF form, salt concentration, nitrite concentration, drying temperature, drying time, marination technique, and slicing thickness on the sensory quality of culled RIR chicken jerky, with the specific objective of identifying the factors that most significantly influence sensory acceptability and that should therefore be prioritized in a subsequent response surface optimization study. The remainder of this paper is organized as follows: Section 2 describes the materials and methods, Section 3 presents the results and discussion, and Section 4 concludes the paper.

2. MATERIALS AND METHODS

A. 2.1 Raw Materials and Procurement

Culled Rhode Island Red (RIR) chicken leg meat was sourced from a local supplier and inspected on delivery for quality, color, and odor before refrigerated storage (0–4 °C) pending processing. RIR leg meat was selected for its relevance to backyard and small-scale poultry operations in the Philippines; its comparatively high myoglobin and intramuscular fat content offers richer flavor potential than commercial broiler cuts, while requiring careful management of texture during drying. The meat was trimmed, cleaned, and ground prior to formulation to produce a restructured jerky format, allowing precise and uniform incorporation of PFAF across treatments.

Passion fruit albedo fiber was procured locally to supply the two experimental forms required by the screening design: a standardized, dried and milled powder (Processed, + level) and fresh albedo prepared in-house without thermal treatment (Fresh, – level). Food-grade sodium chloride and a nitrite-based curing agent were obtained from certified chemical suppliers at concentrations appropriate for testing the 'With' and 'Without' levels specified in the design, together with supplementary marinade components and moisture-barrier packaging materials.

B. 2.2 Plackett-Burman Screening Design

A two-phase statistical strategy was adopted for the overall formulation development of PFAF-fortified RIR chicken jerky: an initial Plackett-Burman screening phase, reported here, followed by a response surface optimization phase using a central composite design. In the screening phase, a 7-variable, 8-run PBD was used to evaluate PFAF form, salt concentration, nitrite concentration, drying temperature, drying time, marination technique, and slicing thickness simultaneously (Table 1), with each variable assigned two levels (Table 2). The design was generated using Statistica software (version 10). This design allowed the seven candidate factors to be evaluated without testing every possible combination, substantially reducing the experimental workload relative to a full factorial design while still allowing the statistically significant factors to be distinguished from the non-significant ones.

TABLE 1: PLACKETT-BURMAN DESIGN MATRIX FOR THE 7-VARIABLE, 8-RUN SCREENING EXPERIMENT.

Run	V1	V2	V3	V4	V5	V6	V7
1	-1	-1	-1	+1	+1	+1	-1
2	+1	-1	-1	-1	-1	+1	+1
3	-1	+1	-1	-1	+1	-1	+1
4	+1	+1	-1	+1	-1	-1	-1
5	-1	-1	+1	+1	-1	-1	+1
6	+1	-1	+1	-1	+1	-1	-1
7	-1	+1	+1	-1	-1	+1	-1
8	+1	+1	+1	+1	+1	+1	+1

V1 = PFAF form; V2 = salt; V3 = nitrite; V4 = drying temperature; V5 = drying time; V6 = marination technique; V7 = slicing thickness.

TABLE 2: VARIABLES AND ASSIGNED LEVELS FOR PLACKETT-BURMAN SCREENING.

Variable	− Level	+ Level	Factor Type
1. PFAF form (g)	Fresh	Processed	Quantitative (continuous)
2. Salt (g)	Without	With	Quantitative (continuous)
3. Curing agent / nitrite (g)	Without	With	Quantitative (continuous)
4. Drying temperature	Low	High	Quantitative (continuous)
5. Drying time (h)	Short	Long	Quantitative (continuous)
6. Marination technique	Vacuum marinator	Manual	Qualitative (categorical)
7. Slicing thickness (mm)	Thick	Thin	Quantitative (continuous)

The actual factor-level assignments corresponding to each of the eight experimental runs are shown in Table 3.

TABLE 3: SEVEN-VARIABLE, EIGHT-RUN PLACKETT-BURMAN DESIGN OF CULLED RIR CHICKEN JERKY.

Run	PFAF	Salt	Nitrite	Drying Temp.	Drying Time	Marination	Thickness
1	Fresh	Without	Without	High	Long	Manual	Thick
2	Processed	Without	Without	Low	Short	Manual	Thin
3	Fresh	With	Without	Low	Long	Vacuum	Thin
4	Processed	With	Without	High	Short	Manual	Thick
5	Fresh	Without	With	High	Short	Vacuum	Thin
6	Processed	Without	With	Low	Long	Vacuum	Thick
7	Fresh	With	With	Low	Short	Manual	Thick
8	Processed	With	With	High	Long	Manual	Thin

C.2.3 Sensory Panel and Evaluation Protocol

A panel of thirty (30) untrained panelists evaluated the eight treatment combinations generated by the Plackett-Burman design. This panel size follows common recommendations for consumer or semi-trained preference and acceptability testing in food product development studies. Panelists were selected based on willingness to participate, absence of known food allergies (particularly to poultry and spices), and regular consumption of processed meat products. Prior to evaluation, panelists were oriented on the mechanics of the 9-point hedonic scale used in the study, where a score of 9 corresponded to "like extremely" and a score of 1 corresponded to "dislike extremely," and were familiarized with the sensory attributes evaluated: color, texture, taste, aroma, spiciness, chewiness, juiciness, springiness, saltiness, and overall acceptability. Panelists used palate cleansers between samples to minimize carryover effects and sensory fatigue, and evaluation sessions were conducted under standardized conditions.

The conduct of the study followed ethical principles governing research involving human participants. Ethical clearance was secured from the appropriate institutional review body, and informed consent was obtained from all panelists confirming voluntary participation, understanding of study procedures, and the right to withdraw at any point without consequence. Confidentiality of individual panelist responses was maintained throughout data collection, analysis, and reporting.

D.2.4 Statistical Analysis

For each of the eight treatment combinations, the sensory score entered into the analysis was the mean rating given by the thirty-panelist panel for that attribute. The estimated effect of each of the seven variables on each of the ten sensory attributes was then calculated as the difference between the average sensory score obtained at the + level and the average score obtained at the − level of that variable, following the sign pattern of the Plackett-Burman design matrix (Table 1). Because the eight-run design used here contains no replicated runs, the standard error required to test each effect was estimated using Lenth's method, in which the median of the absolute values of all effects for a given attribute is used to derive a pseudo standard error; each effect was then evaluated against this pseudo standard error using a t-test at $\alpha = 0.05$. Results were visualized as Pareto charts, in which bars extending beyond the reference line denote statistical significance. Variables identified as significant were prioritized for the subsequent response surface optimization phase, while non-significant variables were fixed at their more favorable practical levels.

3. RESULTS AND DISCUSSION

The estimated effects of the seven screened factors on the ten sensory attributes of PFAF fortified culled RIR chicken jerky are summarized in Table 4, and the corresponding Pareto charts are presented in Fig. 1.

TABLE 4: SUMMARY OF ESTIMATED EFFECTS OF SCREENED FACTORS ON SENSORY ATTRIBUTES OF RIR CHICKEN JERKY FORTIFIED WITH PASSION FRUIT ALBEDO FIBER.

Factor	Color	Texture	Taste	Aroma	Spiciness	Chewiness	Juiciness	Springiness	Saltiness	Overall Acceptability
Mean/Intercept	7.092	6.450	6.633	6.733	6.742	6.617	6.767	6.475	6.817	7.042
PFAF	0.050	-0.500*	-0.167	0.033	-0.183	-0.333	-0.033	-0.250	-0.133	-0.050
Salt	0.850*	0.500*	0.850*	0.433*	0.850*	0.433*	0.567*	0.533*	0.633*	0.650*
Nitrite	-0.633*	-0.167	-0.350	-0.100	-0.367	-0.133	-0.267	-0.083	-0.467*	-0.333*
Drying Temp.	-0.150	0.267	0.250	0.033	0.150	0.167	-0.133	0.167	0.167	0.083
Drying Time	0.300	-0.433	-0.117	0.067	0.033	-0.133	0.067	-0.050	0.000	-0.033
Marination Technique	-0.633	-0.933*	-1.000*	-0.200	-0.867*	-0.500	-0.400	-0.733*	-1.100*	-0.733*
Thickness	0.833	-0.700	-0.200	0.533	0.167	0.000	0.933	-0.267	0.267	0.200

Values are estimated effects (mean response at the + level minus mean response at the − level, in hedonic scale units) from the Plackett-Burman analysis; asterisks (*) denote effects significant at $\alpha = 0.05$. The corresponding standardized effect estimates (each effect divided by its attribute-specific Lenth pseudo standard error) are plotted in the Pareto charts of Fig. 1.

A. 3.1 Effects on Individual Sensory Attributes

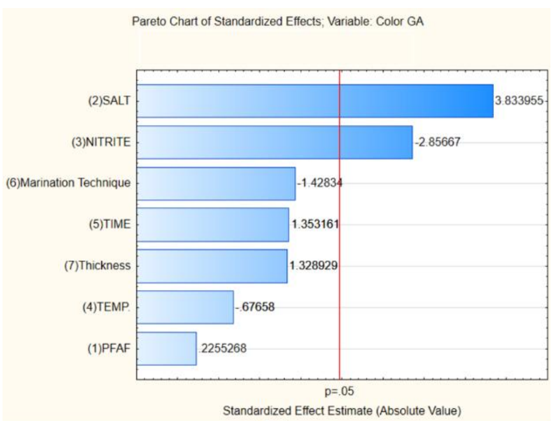
Salt concentration emerged as the most consistently significant variable, producing significant estimated effects across all ten sensory attributes, including color (0.850), texture (0.500), taste (0.850), aroma (0.433), spiciness (0.850), chewiness (0.433), juiciness (0.567), springiness (0.533), saltiness (0.633), and overall acceptability (0.650). This dominance is consistent with the multifunctional role of sodium chloride in meat processing, where it enhances flavor perception while modulating water activity, protein solubilization, and myofibrillar network formation — mechanisms that jointly influence the textural and sensory profile of dried meat products [10]. This consistent, multi-attribute influence of salt aligns with recent findings in other meat products, where salt concentration was likewise shown to be a dominant driver of sensory and physicochemical quality, even at comparatively moderate concentration ranges [11].

Nitrite concentration significantly affected color (–0.633) and saltiness, and also contributed to overall acceptability. Because the + level corresponds to the inclusion of nitrite and the − level to its absence (Table 2), the negative sign indicates that panelists rated color lower when nitrite was included than when it was omitted. This is consistent with nitrite's established role in curing chemistry, in which it reacts with myoglobin to form nitrosylmyoglobin and produce the characteristic pink-red color of cured meat products, with the extent of this reaction influenced by salt concentration [2]; in a jerky product, however, this pink-red cured hue departs from the browner color panelists may associate with a traditionally dried, non-cured product, which may explain the lower color scores observed with nitrite inclusion. While nitrite remains central to cured color development, its continued use has drawn scrutiny due to nitrosamine formation, prompting active research into nitrite reduction strategies and natural alternatives that could inform future reformulation of this product [12], [13].

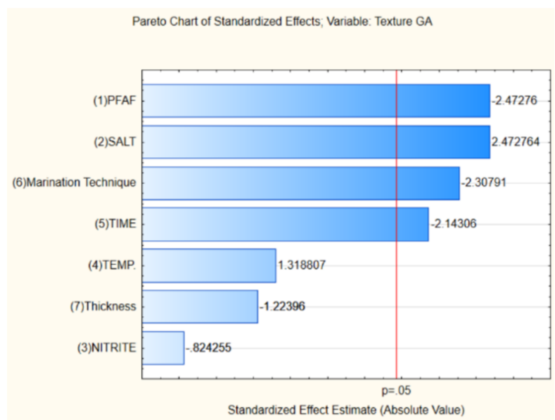
PFAF form significantly influenced texture (–0.500); because the + level corresponds to the processed (dried and milled) form and the − level to the fresh form (Table 2), this negative sign indicates that processed-form samples received lower texture scores than fresh-form samples. This finding supported PFAF form's selection as the primary fiber-related variable for the subsequent optimization study, in which texture profile parameters and physicochemical properties served as key response variables. This effect is consistent with the high water-holding (13.00 g/g) and swelling (37.00 mL/g) capacities reported for passion fruit albedo fiber, which allow it to bind moisture and integrate into the protein matrix of the meat, altering firmness and hardness [1].

Marination technique was statistically significant for texture, taste, spiciness, springiness, saltiness, and overall acceptability, with negative estimated effects for all of these attributes (e.g., –1.000 for taste). Because the + level corresponds to manual marination and the − level to vacuum marination (Table 2), these negative signs indicate that vacuum-marinated samples consistently scored higher than manually marinated samples on these attributes. This is consistent with evidence that tumbling or vacuum marination enhances flavor infusion and tenderness by physically disrupting muscle structure and increasing marinade absorption relative to passive immersion or manual marination [3], [4]. Despite this, vacuum marination represents a substantial capital investment that is largely inaccessible to micro-enterprise and artisanal processors, particularly in the rural, community-based production settings for which this product is intended. Manual marination was therefore fixed as the standard protocol for subsequent trials, as the more viable, replicable, and sustainable approach for the target production scale without materially compromising product quality within the tested range.

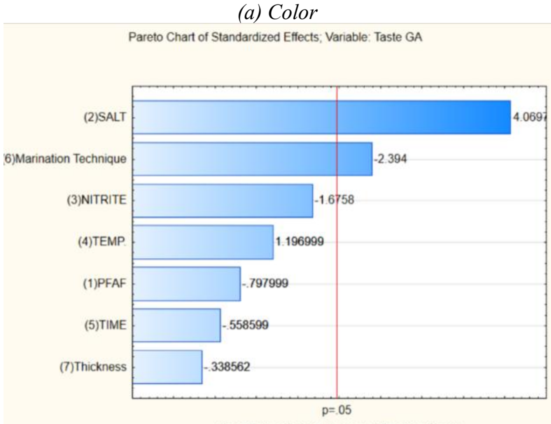
Drying temperature, drying time, and slicing thickness did not register statistically significant effects on overall acceptability within the levels screened here (estimated effects of 0.083, –0.033, and 0.200, respectively) and were therefore fixed at their more favorable levels identified during screening rather than carried forward as optimization variables. This finding is broadly consistent with recent jerky-drying studies, where drying temperature and time primarily affected instrumental texture and color parameters rather than overall consumer acceptability within moderate processing ranges [14], [15], [16].



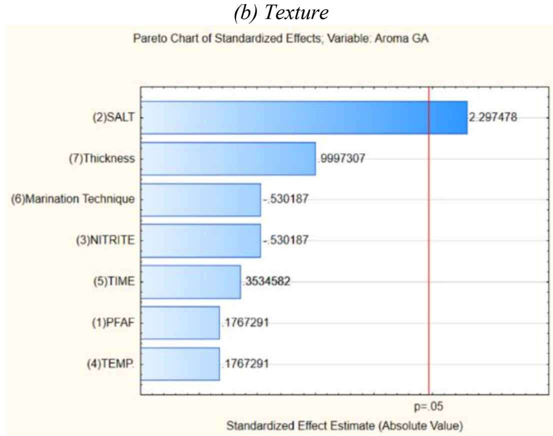
(a) Color



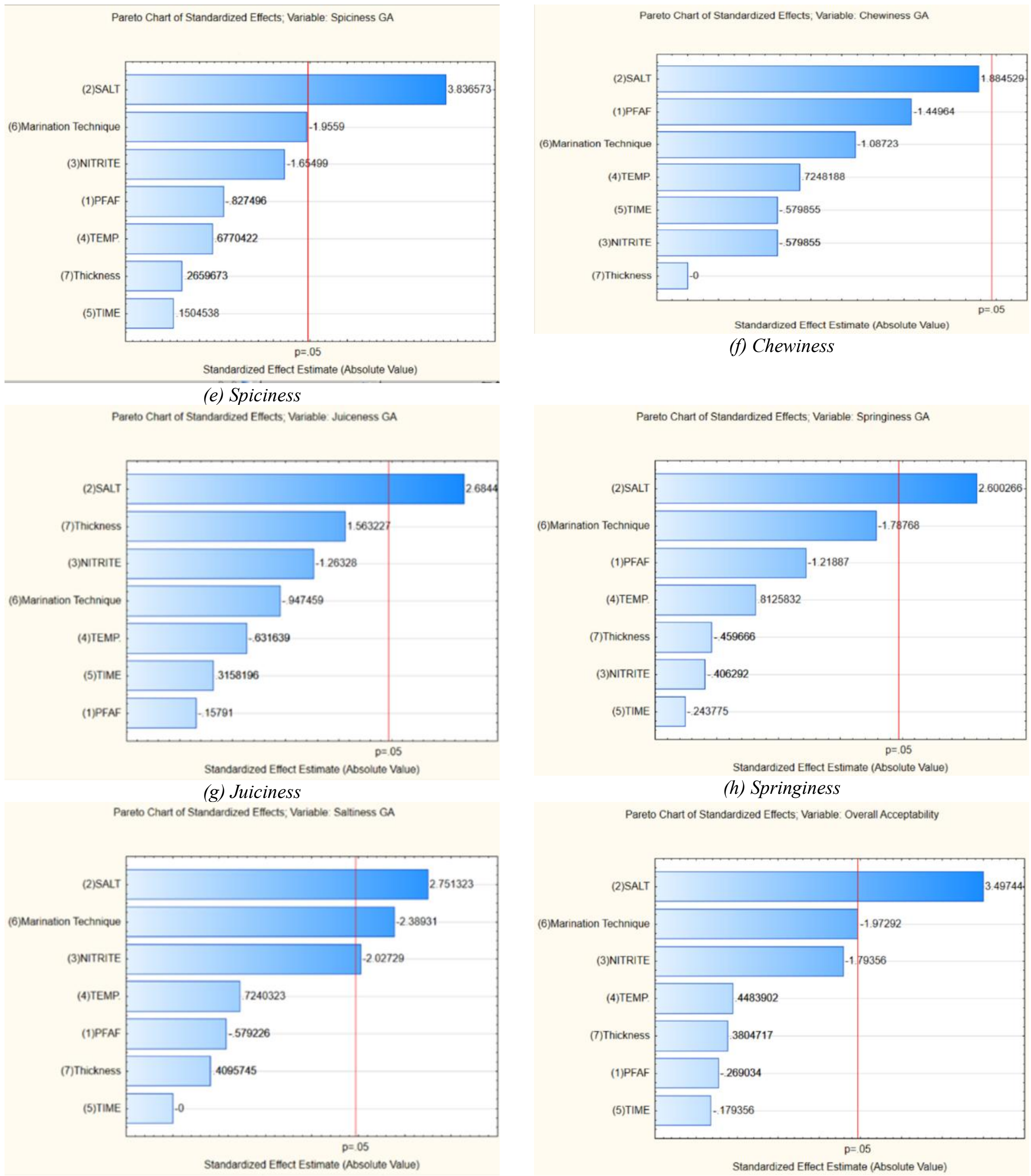
(b) Texture



(c) Taste



(d) Aroma



(e) Spiciness *(f) Chewiness*

(g) Juiciness *(h) Springiness*

(i) Saltiness *(j) Overall Acceptability*

Fig. 1. Pareto charts of the standardized effects of screened variables on the sensory attributes of PFAF-fortified culled RIR chicken jerky: (a) color, (b) texture, (c) taste, (d) aroma, (e) spiciness, (f) chewiness, (g) juiciness, (h) springiness, (i) saltiness, (j) overall acceptability. Bars extending beyond the reference line indicate significance at α = 0.05.

B. 3.2 Selection of Variables for Response Surface Optimization

Based on the screening results, salt concentration, nitrite concentration, and PFAF concentration were selected as the three variables to be carried forward for optimization by response surface methodology (RSM) using a central composite design. This selection is practically justified because RSM requires continuous, numeric variables capable of being varied across defined quantitative ranges to construct meaningful response surface models and optimization curves. Marination technique, although statistically significant for several attributes, is a categorical variable with only two discrete levels and therefore does not lend itself to the polynomial regression modeling that underpins RSM; it was instead fixed at the manual method for the reasons discussed above. Drying temperature, drying time, and slicing thickness, which did not yield statistically significant effects on overall acceptability, were likewise fixed at their more favorable screening levels.

Overall, the screening results indicate that formulation-level variables — particularly salt and nitrite — exert a more consistent and dominant influence on the sensory acceptability of PFAF-fortified culled RIR chicken jerky than the processing parameters evaluated at this stage. This distinction provided the statistical and practical basis for narrowing the seven-factor screening space into a three-factor optimization space, allowing a subsequent central composite design to focus specifically on the variables most likely to produce meaningful curvature and interaction effects on product quality.

4. CONCLUSION

A seven-variable, eight-run Plackett-Burman design efficiently identified the formulation and processing factors that most significantly influence the sensory quality of culled Rhode Island Red chicken jerky fortified with passion fruit albedo fiber. Salt concentration was the dominant factor across all sensory attributes evaluated, followed by marination technique and nitrite concentration, while PFAF form significantly affected texture. Drying temperature, drying time, and slicing thickness did not significantly influence overall acceptability within the tested ranges. On this basis, salt concentration, nitrite concentration, and PFAF concentration were selected as continuous variables for subsequent optimization by response surface methodology, while marination technique was fixed at the manual method and the remaining processing parameters were fixed at their better-performing levels. These findings provide a resource-efficient, evidence-based foundation for the optimization phase of PFAF-fortified culled chicken jerky development and offer a transferable screening framework for other fiber-fortified, dried meat product formulations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] J. H. López-Vargas, J. Fernández-López, J. A. Pérez-Álvarez, and M. Viuda-Martos, "Quality characteristics of pork burger added with albedo-fiber powder obtained from yellow passion fruit (*Passiflora edulis* var. *flavicarpa*) co-products," *Meat Science*, vol. 97, no. 2, pp. 270–276, 2014, doi: 10.1016/j.meatsci.2014.02.010.

[2] J. G. Sebranek and J. N. Bacus, "Cured meat products without direct addition of nitrate or nitrite: What are the issues?," *Meat Science*, vol. 77, no. 1, pp. 136–147, 2007, doi: 10.1016/j.meatsci.2007.03.025.

[3] T. Gao, J. Li, L. Zhang, Y. Jiang, R. Ma, L. Song, F. Gao, and G. Zhou, "Effect of different tumbling marination treatments on the quality characteristics of prepared pork chops," *Animal Bioscience*, vol. 28, no. 2, pp. 260–267, 2015, doi: 10.5713/ajas.14.0511.

[4] Q. Ge, S. Guo, S. Chen, Y. Wu, Z. Jia, Z. Kang, G. Xiong, H. Yu, M. Wu, and R. Liu, "A comparative study of vacuum tumbling and immersion marination on quality, microstructure, and protein changes of Xueshan chicken," *Frontiers in Nutrition*, vol. 9, Art. no. 1064521, 2022, doi: 10.3389/fnut.2022.1064521.

[5] H. Fan and J. Wu, "Conventional use and sustainable valorization of spent egg-laying hens as functional foods and biomaterials: A review," *Bioresource and Bioproducts*, vol. 9, Art. no. 43, 2022, doi: 10.1186/s40643-022-00529-z.

[6] J. Indumathi, M. Shashikumar, G. V. B. Reddy, A. J. Babu, and M. G. Prakash, "Utilization of spent broiler breeder hen meat to develop value-added sausages," *International Journal of Current Microbiology and Applied Sciences*, vol. 8, no. 12, pp. 754–765, 2019, doi: 10.20546/ijcmas.2019.812.099.

[7] M.M. Ciobanu, D.-R. Manoliu, M. C. Ciobotaru, E.-I. Flocea, and P.-C. Boișteanu, "Dietary fibres in processed meat: A review on nutritional enhancement, technological effects, sensory implications and consumer perception," *Foods*, vol. 14, no. 9, Art. no. 1459, 2025, doi: 10.3390/foods14091459.

[8] A. Haque, S. Ahmad, Z. R. A. A. Azad, M. Adnan, and S. A. Ashraf, "Incorporating dietary fiber from fruit and vegetable waste in meat products: A systematic approach for sustainable meat processing and improving the functional, nutritional and health attributes," *PeerJ*, vol. 11, Art. no. e14977, 2023, doi: 10.7717/peerj.14977.

[9] Y.Q. Wen, C.-H. Xue, L.-L. Xu, X.-H. Wang, S.-J. Bi, Q.-Q. Xue, T. Zhang, Y. Xue, Z.-J. Li, G.-D. Chen, and X.-M. Jiang, "Application of Plackett–Burman design in screening of natural antioxidants suitable for anchovy oil," *Antioxidants*, vol. 8, no. 12, Art. no. 627, 2019, doi: 10.3390/antiox8120627.

[10] M. Jůzl, J. Kameník, A. Saláková, B. Macharáčková, F. Ježek, M. Janík Piechowiczová, and J. Slováček, "The effect of salt reduction on sensory, physicochemical, and microbial quality in selected meat products," *Foods*, vol. 14, no. 18, Art. no. 3150, 2025, doi: 10.3390/foods14183150.

[11] M. Zhang, C. Fu, M. Chen, and C. Jin, "The effect of sodium chloride on the physicochemical and textural properties and flavor characteristics of sous vide cooked duck meat," *Foods*, vol. 12, no. 18, Art. no. 3452, 2023, doi: 10.3390/foods12183452.

[12] M. H. Shakil, A. T. Trisha, M. Rahman, S. Talukdar, R. Kobun, N. Huda, and W. Zzaman, "Nitrites in cured meats, health risk issues, alternatives to nitrites: A review," *Foods*, vol. 11, no. 21, Art. no. 3355, 2022, doi: 10.3390/foods11213355.

[13] M. Kim, S. M. Bae, Y. Yoo, J. Park, and J. Y. Jeong, "Clean-label strategies for the replacement of nitrite, ascorbate, and

phosphate in meat products: A review," *Foods*, vol. 14, no. 14, Art. no. 2442, 2025, doi: 10.3390/foods14142442.
[14] D. H. Kim, D.-M. Shin, J. H. Lee, Y. J. Kim, and S. G. Han, "Effect of different brine injection levels on the drying characteristics and physicochemical properties of beef jerky," *Food Science of Animal Resources*, vol. 42, no. 1, pp. 98–110, 2022, doi: 10.5851/kosfa. 2021.e66.
[15] V. A. S. Vidal, R. H. Ølberg, L. Waldenstrøm, I.-J. Jensen, and J. Lerfall, "Influence of drying time and sugar content on the sensory profile of beef jerky," *npj Science of Food*, vol. 9, no. 1, Art. no. 64, 2025, doi: 10.1038/s41538-025-00433-8.
[16] S.M. Kim, T.-K. Kim, H.-W. Kim, S. Jung, H. I. Yong, and Y.-S. Choi, "Quality characteristics of semi-dried restructured jerky processed using super-heated steam," *Foods*, vol. 10, no. 4, Art. no. 762, 2021, doi: 10.3390/foods10040762.