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EFFECT OF SUGAR CONTENT AND DRYING TIME ON THE SENSORY CHARACTERISTICS OF BEEF JERKY

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I. INTRODUCTION

Beef jerky is a frequently consumed meat product worldwide due to its convenience, unique sensory characteristics, and shelf stability. Reduced sugar content in food products is a public health measure, however it poses significant technological and sensorial challenges. Another relevant factor in the beef jerky processing is the drying time due to its economic importance and sustainable production [1]. Taking all these into account, the objective of this study was to evaluate the effects of different drying times (3 and 6 hours) and added sugar content (0.5%and 1.5%) on beef jerky's sensory properties.

II. MATERIALS AND METHODS

Eleven beef loins (*Longissimus lumborum*) were used for each replication of the experiment. The cuts were purchased from slaughterhouses (Trondheim, Norway) with assured hygienic quality. The beef jerky samples were prepared according to Yang, Hwang [2] with some modifications to evaluate the effects of drying time and sugar content. The differences between the treatments were as follows: BJ1: 0.5% sugar + 3 hours of drying; BJ2: 0.5% sugar + 6 hours of drying; BJ3: 1.5% sugar + 3 hours of drying; BJ4: 1.5% sugar + 6 hours of drying.

The beef loin was sliced using a meat slicer to a thickness of 5 mm (Compact 1 RIS518010 Ritter, Germany). Subsequently, the slices underwent a salting step for 18 hours at 3 °C using 70% water, 1.5% NaCl, and 150 ppm $NaNO_2$ based on the weight of the meat, varying only the sugar content. After the salting step, the samples were smoked in a smoking chamber (CS700 EL MAXI 1001, Germany) After smoking step, the drying process was conducted, varying the drying time utilizing 70 °C.

All sensory analyses were conducted in accordance with the Principles of Good Practice [3]. The sensory analyses were conducted in the sensory laboratory, a room designed in accordance with the ISO standard "General guidance for the design of test rooms" ISO 8589:2007 at the Department of Biotechnology and Food Science at the Norwegian University of Science and Technology, Trondheim, Norway.

First, a semi-trained panel consisting of 10 assessors (aged between 20 and 49 years), with prior experience and familiarity with meat products, was employed to generate the sensory profile of the samples. The repertory Grid method [4] was applied to identify and describe the similarities and differences in the attributes of appearance, aroma, flavor, and texture of the samples. The selected descriptors were used as check options for the subsequent check-all-that-apply (CATA) questionnaire [5]. Secondly, a consumer panel consisting of 93 participants, conducted a CATA questionnaire combined with acceptance on the beef jerky samples. The acceptance was rated using a 9-point structured hedonic scale (1 – extremely disliked to 9 – extremely liked) [6] followed by the CATA questionnaire where the participants selected the attributes that they believed best described the samples [5]. Finally, the consumers selected the attributes that best described the ideal product [6].

An acceptance test was determined using the "bar chart of means" function in EyeOpenR (version 6.0.4.2, West Malling, UK) and analyzed through one-way analysis of variance (ANOVA) with Tukey's post hoc test, where statistical differences were identified at $\alpha = 0.05$ in SPSS Statistics (version 29.0.1.0, IBM Corp, New York, USA). The statistical relationship between the samples and the CATA sensory characteristics was analyzed using Cochran's Q test and McNemar's test, as well as Correspondence Analysis (CA) in EyeOpenR. The acceptance test and CATA results were combined in a Just About Right analysis with the ideal in EyeOpenR.

III. RESULTS AND DISCUSSION

The results of the acceptance test can be seen in **Figure 1**. The mean acceptance scores were considered neutral for all samples, ranging from 4.77 to 5.02, with no significant difference ($P > 0.05$).

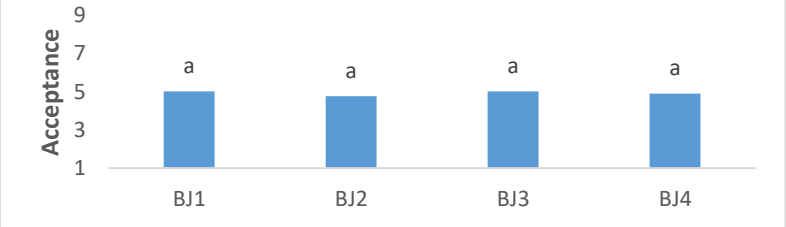


Figure 1. Acceptance values of beef jerky treatments.

This suggests that reducing the added sugar content and drying time during processing is possible without affecting the final product's acceptance. These results are significant due to the importance of reducing sugar consumption to make foods healthier, especially in meat products with high sodium content like beef jerky. Additionally, reducing drying time can increase time and cost efficiency in the food industry.
Evaluating the CATA questionnaire results, a significant difference ($P < 0.05$) between the samples was observed in 7 sensory descriptors: red and brown color, astringent, chewy, crispy, tender, and juicy. Consumers identified significant differences ($P < 0.05$) primarily in texture attributes (chewy, crispy, tender, and juicy) among the beef jerky samples. Additionally, participants did not perceive differences between samples based on the added sugar content (0.5% or 1.5%) during processing. However, varying drying times (3 or 6 hours) significantly influenced the results ($P < 0.05$).
During the sensory evaluation, the panelists were asked to select which sensory attributes in beef jerky samples they desired in an ideal product. To map these desired sensory characteristics for an ideal product, Correspondence Analysis (CA) was conducted including the ideal product, as shown in **Figure 2**. Evaluating the positions of the samples on the CA, it was mainly the drying times that influenced the attributes

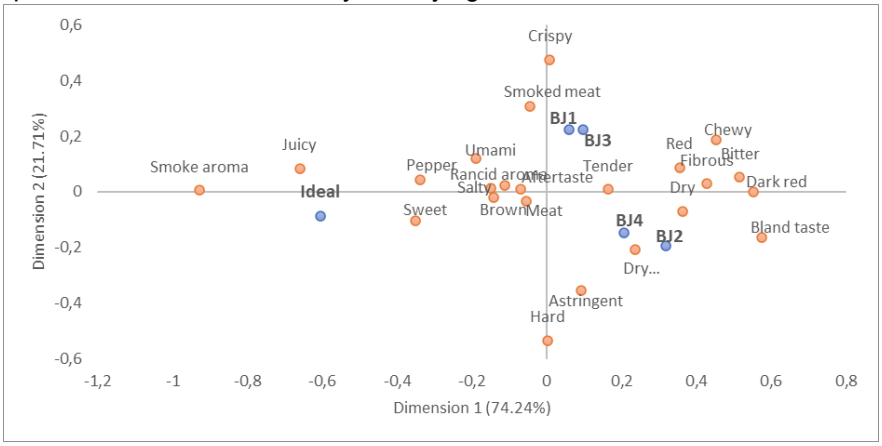


Figure 2. Representation (n=93) of the samples, ideal product, and the sensory attributes in the first and second dimensions of the correspondence analysis on data questions check-all-that-apply (CATA)

IV. CONCLUSION

The ideal product demonstrated that reducing the added sugar content is possible without affecting the sensory attributes considered ideal by consumers. Additionally, samples using the same drying time exhibited similar sensory characteristics. Evaluating the CATA questionnaire, different drying times significantly affected the following sensory descriptors according to the panelists: red and brown color, astringent, chewy, crispy, tender, and juicy. However, the drying time and added sugar content did not significantly affect consumer acceptance. These results suggest that reducing the added sugar and drying time without significant effects on the sensory acceptance of beef jerky samples is possible, making the product healthier and production more efficient.

ACKNOWLEDGEMENTS

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