Nutritional and sensory properties of frankfurter sausages with cricket flour as a meat replacer

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Objectives: This work aimed to investigate the effects of replacing pork meat with cricket flour at different ratios (2.5% and 5.0%) on the proximate composition and sensorial properties of frankfurters.

Materials and Methods: Three different frankfurter sausages were manufactured according to Pintado et al. (2016). Control treatment (CT) constituted of pork meat (60%), pork backfat (19%), water/ice (18.73%), sodium chloride (1.45%), seasoning (0.5%), sodium tripolyphosphate (0.3%), and sodium nitrite (0.012%), and two other treatments consisted of the same ingredients as control, but with the addition of 2.5% (IH2.5), and 5.0% (IH5.0) of cricket flour as meat replacement. The proximate composition (moisture, fat, protein and ash) was determined according to official methodologies (AOAC, 2005). The sensory attributes of frankfurter sausages were evaluated by 15 panelists who were familiar with the product and with previous experience in sensory evaluation of meat products. A hedonic scale rating test was carried out where appearance, color, texture, taste, aroma, and general acceptability were evaluated on a 10 cm structured line scale with the terms "I completely dislike" and "I like very much" at each extreme. The purchase intention test was conducted and the terms "I definitely would not buy" and "I definitely would buy" were on the line scale. One-way analysis of variance was carried out to analyze the effect of different levels of cricket flour as a meat re- placer on frankfurter sausages. Means were compared using Tukey's HSD test ($p < 0.05$).

Results and Discussion: The meat replacement with cricket flour influenced on the proximate composition of frankfurter sausages. The moisture content ranged between 58.84 and 61.52 g/100 g and compared with the CT, it gradually decreased significantly with increasing cricket flour addition. The lowest ($p < 0.05$) moisture content was found at a 5.0% replacement meat ratio. On the other hand, the protein content of IH2.5 and IH5.0 was significantly higher than that of the CT. As expected, the highest ($p < 0.05$) protein content was found at the IH5.0 treatment with values of 16.87 g/100 g. These results are a consequence of the higher protein but lower moisture content of cricket flour compared to pork meat. The fat level of sausages varied from 20.32 to 20.73 g/100 g, with no significant difference between CT and IH2.5 and IH5.0. The ash content of sausages was lower ($p < 0.05$) in IH2.5, but there were no significant differences between the control and IH5.0 treatment (values varied from 2.28 to 2.41 g/100 g). Similarly, other studies also related an increase in protein content of meat products with edible insects (Kim et al., 2016; Kim et al., 2017). About the sensory properties, some attributes were affected ($p < 0.05$) by the incorporation of cricket flour. In general, the IH2.5 treatment had no significant differences in sensory properties when compared with the control treatment. However, treatment IH5.0 showed lower ($p < 0.05$) scores in taste and aroma. IH5 exhibited lower ($p < 0.05$) scores for appearance and color attributes, prob- ably due to the brownish-color appearance. Panelists also reported bitter taste and aftertastes for sausages with higher cricket flour addition. On the other hand, no significant differences were found for texture attributes among treatments. Values for purchase in- tention varied from 5.66 to 7.44 and lower ($p < 0.05$) scores were found for IH5.0 treatment.

Conclusion: The replacement of meat with cricket flour on frankfurter sausages may be a viable option for more sustainable meat products reformulation attending mainly to protein content criteria. The amount of cricket flour added influences the sensory properties of the final product mainly in flavor and color attributes. Future interventions in the formulation may be conducted to improve the sensory characteristics of frankfurters with higher (5%) cricket flour addition as meat replacer, especially regarding these sensory parameters. *Acknowledgements* This research was supported by the projects: PID2019-107542RB-C21; 201470E073; 202070E242); CYTED (119RT0568; Healthy Meat network); FAPESP 2019/22501-8. The authors would like to thank to CAPES, Ministry of Education of Brazil.

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