INSECTS (*Acheta domesticus and Tenebrio molitor*) POWDER AS PARTIAL MEAT REPLACER IN FRANKFURT-TYPE SAUSAGES

J. Fernández-López[1*], J. Rodríguez-Párraga[1], C. Botella-Martínez[1], R. Lucas-González[1], M. Viuda-Martos[1], J.A. Pérez-Alvarez[1]

[1] Institute for Agri-Food and Agri-Environmental Research and Innovation, Miguel Hernández University (CIAGRO-UMH), Ctra. Beniel km 3.2, 03312 Orihuela, Alicante, Spain.

*Corresponding author email: j.fernandez@umh.es

I. INTRODUCTION

Edible insects have gained relevance in last years because of their high nutritional value (source of proteins and unsaturated fatty acids) and sustainable production (low emissions of greenhouse gases and reduced use of natural resources) [1], in line with the goals required by the agrifood chain for a more efficient and sustainable food production. It is worth noting that, although international organizations defend the benefits of entomophagy, attitudinal barriers still persist in Western societies [2]. It is thought that this rejection of insect consumption will be lessened if they are incorporated into the diet not as such, but in the form of powders for use as food ingredients. In this way, the aim of this work was to evaluate the feasibility of including powders from edible insects (*Acheta domesticus* and *Tenebrio molitor*) as partial beef meat replacers in cooked sausages (Frankfurt-type) and their effect on their nutritional, technological, and sensory properties.

II. MATERIALS AND METHODS

Frankfurt-type sausages with 65% beef meat and 35% pork backfat (100% meat); and 20% water, 2.5% sodium chloride, 300 mg/kg sodium tripolyphosphate, 150 mg/kg sodium nitrite, 2 g/kg power smoke and 0.3% spices, were elaborated following a traditional procedure. Insect powders (TM: *T. molitor* and AD: *A. domesticus*) were used for the 7.5% (7.5%TM and 7.5% AD) and 15% (15%TM and 15% AD) beef meat replacement. Proximate composition, emulsion stability (total expressible fluid; TEF (%)), pH, and CIELAB color properties were assessed. Consumer panelist scored the samples for flavor, taste, hardness, juiciness, color and overall appearance. Significant differences were determined by means of ANOVA and Tukey test ($p<0.05$).

III. RESULTS AND DISCUSSION

Table 1 shows the proximate composition and technological properties of sausages with insect powders. The partial replacement of beef meat by insect powders resulted in sausages with lower moisture and higher protein than control ($p<0.05$). The protein content was higher when AD powder was added than in the case of TM, what is related to the protein content in both powders [3]. Sausages added with TM powder showed higher fat content than control but this content was lower when AD powder was used ($p<0.05$) which can be attributed to the fat content of both powders [3]. Not only is important the fat content but the fatty acid profile, and it has been reported that insect powders have higher polyunsaturated fatty acids content than beef meat. The use of insect powders increased the emulsion stability, without differences between the type of powder used but dependent on the concentration; the higher the replacement percentage, the higher the emulsion stability ($p<0.05$). The addition of insect powders resulted in sausages with less lightness (dependent on powder concentration but not on powder type) and redness (lower redness when AD powder was used) than control.

Table 1 – Proximate composition and physicochemical properties of sausages with insect powders.

Sample	Control	7.5%TM	15%TM	7.5%AD	15%AD
Moisture (%)	70.93±0.29^{a}	66.76±0.02^{b}	64.93±0.55^{c}	67.63±0.47^{b}	65.57±0.31^{c}
Ash (%)	1.82±0.07^{a}	1.91±0.15^{a}	1.86±0.14^{a}	1.95±0.23^{a}	1.71±0.65^{a}
Fat (%)	9.24±0.43^{b}	10.23±0.44^{a}	10.10±0.39^{a}	8.41±0.52^{c}	8.13±1.09^{c}
Protein (%)	16.15±0.10^{c}	16.38±0.09^{c}	17.31±0.23^{b}	17.79±0.25^{b}	19.19±0.37^{a}
TEF(%)	14.76±2.45^{a}	9.57±1.01^{b}	2.98±0.58^{c}	11.90±2.14^{ab}	3.77±1.71^{c}
pH	6.02±0.03^{d}	6.10±0.02^{c}	6.28±0.02^{a}	6.15±0.02^{b}	6.16±0.01^{b}
L*	58.45±2.16^{a}	55.27±3.09^{b}	54.37±1.71^{c}	55.69±1.39^{b}	51.70±1.13^{c}
a*	7.34±0.56^{a}	6.32±0.49^{b}	5.82±0.83^{c}	5.40±0.40^{c}	5.60±0.24^{c}
b*	8.38±0.23^{c}	10.21±0.75^{a}	10.17±1.28^{b}	8.56±0.56^{ac}	8.38±0.38^{c}

$^{a-c}$: different letters in the same row indicate significant differences among formula.

The used of insect powders (TM and AD) for the beef meat replacement at 7.5% resulted in sausages with good sensorial acceptance (all the attributes evaluated were scored higher than 5) (Figure 1). Higher substitution levels (15%) resulted in sausages with low scores, mainly in overall taste and flavor when TM powder was used, and even in appearance, juiciness and color for AD powder.

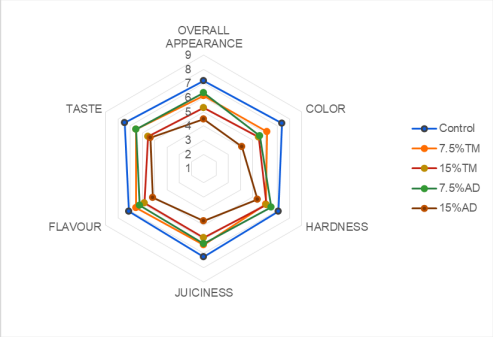

Figure 1. Sensory properties of Frankfurt-type sausages with insects powder as partial meat replacer

IV. CONCLUSION

The use of insect powders for the partial replacement of beef meat in Frankfurter-type sausages is a technologically viable option that opens the door to their use as a protein source in the development of more sustainable meat products, although its negative effect on some sensory characteristics still needs to be improved.

ACKNOWLEDGEMENTS

Thanks to the project “Looking for new sources of ingredients in the development of sustainable meat products (Ref: SPRINTUMH2023_1)”, to the Spanish Ministerio de Universidades for Margarita Salas Requalification’postdoctoral fellowship (funded by the European Union–Next Generation EU) of RLG, and to the Miguel Hernández University for the research grant of CBM.

REFERENCES

1. Lucas, A.J.; da Oliveira, L.M.; da Rocha, M.; Prentice, C. (2020). Edible insects: an alternative of nutritional, functional and bioactive compounds. Food Chemistry 311:126022.
2. Orkusz, A.; Wolanska, W.; Harasym, J.; Piwowar, A.; Kapelko, M. (2020). Consumers’ attitudes facing entomophagy: polish case perspectives. International Journal of Environmental Research & Public Health 17: 2427.
3. Lucas-González, R.; Fernández-López, J.; Pérez-Álvarez, J.A. et al. (2019). Effect of drying processes in the chemical, physico-chemical, techno-functional and antioxidant properties of powders obtained from house cricket (*Acheta domesticus*). European Food Research & Technology 245: 1451–1458