ASSESSMENT OF THE NUTRITIONAL AND QUALITY IMPACT OF ADDING PITAHAYA (*Hylocereus ocamponis*) PULP FLOUR TO FRANKFURT SAUSAGES

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I. INTRODUCTION

Frankfurt-type sausage is a popular processed meat. This product, as well as other processed meat products, have been associated with the development of certain non-communicable diseases potentially explained by the high-fat content (15-30%) and quality of these fats (mostly saturated fatty acids). The addition of co-products derived from fruits and vegetables is a viable alternative to reduce the alleged harmful effects on the human health of this type of product. This is often ascribed to the protective properties of dietary fiber, whose components, have been widely demonstrated to be capable of limiting fats and sugars absorption. Pitahaya, pitaya, or dragon fruit is a tropical and subtropical fruit belonging to the Cactaceae family. The pulp of this fruit, which may be white or red, shows a high content of phytochemicals, including (poly)phenolic compounds, betalains, and dietary fiber. With the appropriate industrial treatment, it is possible to obtain potential ingredients to be used in the food industry. Therefore, this study aimed to use the flour obtained from pitahaya pulp in the formulation of Frankfurt-type sausages and determine its effect on the chemical and technological properties of these products.

II. MATERIALS AND METHODS

Frankfurt-type sausages were made following a conventional formulation [1]. Three different formulations were prepared: the original formula was used as control sample (CS). The other samples were formulated by adding 1.5% (FPPF1.5) and 3% (FPPF3) of lyophilized pitahaya pulp flour (PPF). Chemical composition and residual nitrite level (mg $NaNO_2$/kg sample) were determined according to AOAC methodology [2]. The pH values were assessed using a penetration probe, at different sites of the sample, connected to a pH-meter. The emulsion stability was evaluated as the percentage of total expressible fluid (TEF) [3] while the color parameter was analyzed in the CIEL*a*b* space. Data analysis was performed using a one-way ANOVA test and differences were considered significant at $p < 0.05$.

III. RESULTS AND DISCUSSION

Table 1 shows the chemical composition of Frankfurt-type sausage added with PPF. The protein and fat content did not present significant differences ($p > 0.05$) between the control sample and the samples with added PPF. The moisture and ash content showed a slight decrease ($p < 0.05$) in samples with added PPF with respect to CS. Regards the residual nitrite content, as the concentration with added PPF increased, the residual nitrite levels decreased and showed significant differences (p <0 .05) with respect to CS. This reduction could be due to an interaction of nitrite with the different bioactive compounds present in PPF, mainly flavonoids, and betalains.

Table 1 – Chemical composition of Frankfurt-type sausage added with pitahaya pulp flour

	Moisture	Protein	Fat	Ash	Residual $NaNO_2$
CS	35.65 ± 0.09^{b}	15.87 ± 0.17	13.81 ± 0.14	1.70 ± 0.09^{a}	35.65 ± 0.89^{a}
FPPF1.5	34.80 ± 0.16^{a}	16.23 ± 0.44	12.72 ± 0.14	1.63 ± 0.08^{ab}	31.23 ± 1.09^{b}
FPPF3.0	34.89 ± 0.38^{a}	16.27 ± 0.13	13.40 ± 1.03	1.51 ± 0.03^{b}	28.39 ± 0.96^{c}
ANOVA	*	n.s.	n.s.	*	*

Values expressed as g/100 sample. All data are presented as means ± standard error. Asterisks indicate significance at * $p < 0.05$; n.s. not significant. Values followed by same letter in the same column were significantly different according to Tukey's HSD post-hoc test ($p < 0.05$).

The pH, the emulsion stability, and CIELAB color coordinates values of Frankfurt-type sausage are shown in Table 2. The addition of PPF had no effect ($p > 0.05$) on pH values. In the same way, the emulsion stability reported as total expressible fluid (TEF %) was not affected by the addition of PPF. However, all color parameters were deeply affected ($p< 0.05$) by the use of PPF as an ingredient and this occurred in a concentration-dependent manner. Thus, the L* and b* parameters decreased the values whilst the a* increased. This result was expected because the pulp of the pitahaya shows a reddish color due to the presence of betalains and anthocyanins in its composition.

Table 2 –Physico-chemical properties of Frankfurt-type sausage with added pitahaya pulp flour.

			Color parameters		
	pH	TEF (%)	L*	a*	b*
CS	5.92 ± 0.07	1.20 ± 0.12	69.71 ± 0.14^{a}	4.32 ± 0.23^{c}	8.85 ± 0.49^{a}
FPPF1.5	5.99 ± 0.01	1.39 ± 0.11	66.28 ± 0.25^{b}	10.38 ± 0.62^{b}	6.38 ± 0.59^{b}
FPPF3.0	5.99 ± 0.04	1.48 ± 0.21	63.70 ± 0.13^{c}	13.20 ± 0.51^{a}	6.13 ± 0.19^{b}
ANOVA	n.s.	n.s	*	*	n.s.

All data are presented as means ± standard error. Asterisks indicate significance at * $p < 0.05$; n.s. not significant. Values followed by same letter in the same column were significantly different according to Tukey's HSD post-hoc test ($p < 0.05$).

IV. CONCLUSION

The addition of pitahaya pulp flour seems to be a technologically viable alternative for elaborating emulsified cooked cured meat products, such as Frankfurt-type sausages. In addition, pitahaya pulp flour could have a great potential to be used in the meat industry as an ingredient for reducing the residual nitrite levels and could improve the "natural" and "healthy" image of these products, among consumers.

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