POTENTIAL OF TAMARIND (*TAMARINDUS INDICA* L.) AS MEAT REPLACER IN FRANKFURTERS

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I. INTRODUCTION

Meat is highly nutritious, but some meat products, such as frankfurter sausages, particularly some of their components, are often considered unhealthy [1]. In response to the demand for healthier options, the concept of incorporating vegetables into meat products is gaining attention [2]. Brazil is recognized for its tropical fruit production, and the tamarind stands out. Thus, tamarind and its by-products in meat products are rich in healthy compounds such as vitamins and minerals, which could be an interesting option. Previously, some authors have used freeze-dried tamarind powder as a beef tenderizer [3]. Hence, the use of tamarind or its by-products can help develop healthier meat products and enhance their quality. Thus, the present study aimed to investigate the effect of different components from tamarind (pulp, seeds, peel) as meat replacers on the proximal composition, technological, and microbiology characteristics of frankfurters.

II. MATERIALS AND METHODS

To prepare the pulp, seeds, and peel from tamarind, the inner part of the fruit was soaked in water at a 1:1 (w/v) ratio and chilled storage for 24 hours. The pulp and seeds were manually separated, and then the seeds and peel were ground. Five types of frankfurters were prepared [4] replacing 5% of pork meat with 5% of tamarind components, resulting in the following treatments: a control without tamarind (T0), 5% of tamarind pulp (PT5), 5% of seeds (ST5), 5% of peel (CT5), and 5% of a mixture of them (PSCT5) as meat replacer. T0 was formulated with pork meat (60%), pork backfat (19), water (18.5%), and additives (2.5%), while in the rest of the samples, pork meat was replaced with 5% of each tamarind component. All ingredients were homogenized (Thermomix® TM6-1, Vorwerk Elektrowerke GmbH & Co., Germany), and the mixture was stuffed into cellulose casings (Viscase S. A., France) and heat-processed in a steam oven (Micro 40, Eller, Merano, Italy) at 80 °C and 99% RH for 60 minutes. After processing, the frankfurters were cooled until the next day, when the casings were removed. The proximate composition, processing loss (PL), pH, and microbiological analysis of frankfurters (Total viable count (TVC), Enterobacteriaceae, and mold and yeasts) were then performed. Analysis of variance and Tukey's HSD test were done, and differences were significant when $p < 0.05$.

III. RESULTS AND DISCUSSION

Using tamarind components as meat replacers significantly affected frankfurters' moisture, protein, fat, and ash content (Table 1). Moisture content ranged from 53.62 to 57.46 g/100 g. ST5 and PSCT5 did not significantly alter moisture content compared to T0 (Table 1). Regarding protein, T0 showed the highest ($p < 0.05$) content (Table 1) according to formulation since tamarind parts replaced pork meat, the primary protein source. Regarding fat, all samples with tamarind showed higher ($p < 0.05$) values than T0 (Table 1), probably due to the fat content of pulp, seed, and peel. Ash values of ST5, CT5 and PSCT5 were higher ($p < 0.05$) than T0, while PT5 showed similar ($p > 0.05$) values than T0. The moisture, protein, fat, and ash values in our study align with those reported by other studies on frankfurter [2]. The PL of frankfurters ranged from 6.02 to 16.46%. ST5 and PSCT5 showed lower ($p < 0.05$) PL than T0, while CT5 showed similar ($p > 0.05$) PL than T0. PT5 had the highest ($p < 0.05$)

PL. The pH values of frankfurters ranged from 6.16 to 6.41, with the lowest ($p < 0.05$) value in the PT5 and the highest ($p < 0.05$) in the T0 and ST5 treatments ($p < 0.05$) (Table 1). The lower pH is probably related to the acid pH of tamarind pulp (3.45), while the seeds and peel showed higher pH values (5.44 and 4.40, respectively). Regarding the TVC, values ranged from 1.65 log CFU/g (for the PSCT5 treatment) to 2.41 log CFU/g (for the CT5 treatment) ($p < 0.05$) (Table 1). The counts for Enterobacteriaceae and molds and yeasts were below the detection limits of the employed technique.

Table 1 – Proximal composition (g/100 g), processing loss (%), pH values, and microbiological analysis (log CFU/g) of frankfurters.

	Treatments				
	T0	PT5	ST5	CT5	PSCT5
Proximate composition					
Moisture	57.46 ± 0.22^{a}	55.74 ± 0.21^{b}	56.76 ± 0.44^{a}	53.62 ± 0.45^{c}	57.19 ± 0.30^{a}
Protein	16.23 ± 0.30^{a}	15.13 ± 0.34^{b}	13.75 ± 0.17^{c}	15.30 ± 0.36^{b}	14.03 ± 0.11^{c}
Fat	20.40 ± 0.61^{d}	24.75 ± 0.18^{a}	21.31 ± 0.12^{c}	23.36 ± 0.14^{b}	22.77 ± 0.35^{b}
Ash	2.44 ± 0.03^{c}	2.51 ± 0.01^{bc}	2.52 ± 0.04^{b}	2.59 ± 0.00^{a}	2.54 ± 0.01^{ab}
Processing loss	13.36 ± 0.71^{ab}	16.46 ± 2.82^{a}	6.02 ± 2.59^{d}	13.12 ± 0.70^{bc}	9.99 ± 1.77^{c}
pH	6.41 ± 0.02^{a}	6.16 ± 0.02^{c}	6.41 ± 0.01^{a}	6.20 ± 0.01^{b}	6.19 ± 0.01^{b}
Microbiological analysis					
TVC	1.84 ± 0.34^{ab}	2.34 ± 0.03^{ab}	1.83 ± 0.18^{ab}	2.41 ± 0.10^{a}	1.65 ± 0.07^{b}

Mean ± SD. Different superscript letters in rows (a-d) indicate statistically significant differences ($p < 0.05$).

IV. CONCLUSION

The study indicated that using different parts of tamarind (pulp, seeds, peel, or a combination) is a viable option to replace meat pork in frankfurters from a nutritional and microbiological point of view. Considering technological aspects, in terms of processing loss, using tamarind seed and peel as meat replacers in frankfurters resulted in the best options. This reformulation procedure improved the sustainable aspect of the production of frankfurters.

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REFERENCES

1. Herrero, A.M.; Ruiz-Capillas, C. (2021) Novel lipid materials based on gelling procedures as fat analogues in the development of healthier meat products. Current Opinion in Food Science, 39: 1-6.
2. Pereira, J.; Brohi, S.A.; Malairaj, S.; Zhang, W.; Zhou, G.-H. (2020) Quality of fat-reduced frankfurter formulated with unripe banana by-products and pre-emulsified sunflower oil. International Journal of Food Properties, 23(1): 420-433.
3. Silva, A.L.C.; Lúcio, A.S.; Mendes, B.S.; Pontes, E.D.S.; Santos, R.M.S.; Coutinho, E.B.; Oriente, S.F.; Baía, S.R.D.; Gusmão, R.P.; Gusmão, T.A.S. (2022) Development of meat tenderizer with freeze-dried tamarind powder. Research, Society, and Development, 11(9): e22411931510.
4. Cavalheiro, C.P.; Ruiz-Capillas, C.; Herrero, A.M.; Pintado, T.; Cruz, T.M.P.; Silva, M.C.A. (2023) Cricket (*Acheta domesticus*) flour as meat replacer in frankfurters: Nutritional, technological, structural and sensory characteristics. Innovative Food Science & Emerging Technologies, 83: 103245.