EVALUATION OF THE EMULSION STABILITY AND TEXTURE PROFILE IN EMULSIFIED AND COOKED MEAT PRODUCT WITH ADDED DIETARY FIBERS AND REDUCED PORK BACK FAT

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Abstract – The effect of addition of soluble and insoluble fibers - fructooligosaccharide, inulin, oat fiber, wheat fiber and alpha cyclodextrin in emulsified and cooked meat product with 50% fat reduction was studied. Twelve treatments were realized: two controls with no added fibers one of them with 50% fat reduction and ten treatments with 3 and 6% of fibers added. The results showed that the addition of fibers with fat reduction in emulsified and cooked meat product can help in emulsion stability, but the addition of fructooligosaccharides and inulin can reduced emulsion stability when compared to controls treatments. Higher values to hardness and chewiness was obtained when oat fiber and wheat fiber was used. The addition of 3% of alpha cyclodextrin and 50% fat reduction had the best result found to cooking loss. The addition of 6% of alpha cyclodextrin and 50% fat reduction had the best result found to hardness, similar C1 treatment. The chewiness had similar results to C1 treatment when 3% of soluble fibers were used (alpha cyclodextrin, fructooligosaccharides and inulin) and 50% fat reduction, or 6% of alpha cyclodextrin and 50% fat reduction. Considering the conditions of this study, alpha cyclodextrin proves to be an efficient ingredient in the application in meat product.

Key Words – soluble fibers, insoluble fibers, fat substitute.

I. INTRODUCTION

Emulsified meat products are widely consumed because they are practical products and there is an increasing demand for meat products with decreased fat. Fat is an essential component in meat and meat products because of its functional and sensorial properties. However, meat products have been criticized for their high sodium content, low fiber content and high animal fat level in several formulations (20 - 30%), often being considered harmful to health [1]. An excessive intake of fat especially saturated fat and cholesterol are associated with chronic disease like cardiovascular disease, cancer, type 2 diabetes, hypertension and others related to obesity [2].

Various types of fibers have been added to meat products to improve textural properties, emulsion stability and water-holding capacity. The functionally significant dietary fiber can easily improve the healthy beneficiary characters and the consumer acceptance of meat products added with it. The overall acceptance of the dietary fiber added meat products has increased positively in recent time [3]. The dietary fiber can increase acceptability by improving nutritional components and replacing the unhealthy fat components from the meat products.

The objective of this study was to evaluate the influence of the addition of 3 and 6% soluble and insoluble dietary fibers (inulin, fructooligosaccharides, oat fiber, wheat fiber and alpha cyclodextrin) to emulsified and cooked meat product with 50% fat reduction, on the physicochemical parameters, texture profile, emulsion stability and cooking loss.

II. MATERIALS AND METHODS

The raw materials were thigh and drumstick chicken with skin, mechanically deboned chicken meat and pork back fat. Three soluble fibers (inulin Orafti® - Clariant, fructooligosaccharides Ingredion® and alpha cyclodextrin Wacker® - Vogler) and two insoluble fibers (oat fiber J. Rettenmaier & Söhne®, wheat fiber Nutrassim®) were used.

Twelve treatments were produced. All treatments were added to: 40% thigh and drumstick chicken with skin; 25% mechanically deboned meat chicken, 2% salt; 0,5% sodium erytorbate; 2,185% cassava starch, 0,3% sodium tripolyphosphate; 0,015% sodium nitrite and ice in an amount sufficient to complete 100%. Table 1 shows the quantities of pork back fat and dietary fibers added in each treatment. All ingredients were weighed. The meat and the other ingredients were homogenized and emulsified. Each treatment was placed in a roasting tin and cooked until the geometrical center reached 72ºC. After it had cooled, it was cut into 2 cm slices, vacuum packed and stored under refrigeration.

The treatments were characterized for moisture, protein, and ash content according to AOAC [4] and fat content was determined according to the Bligh & Dyer's method [5].

Cooking loss and emulsion stability were analyzed according to Jimenez-Colmenero, Ayo, and Carballo [6]. Hardness and chewiness of the emulsified and cooked meat product were determined in the sliced samples using a TA-XT/Plus/50 Texture Analyser (Stable Micro Systems, Haslemere, Surrey, England). The data were analyzed using Tukey´s test and ANOVA, at 5% significance level.

III. RESULTS AND DISCUSSION

Table 2 shows the results of tests for chemical composition, emulsion stability of treatments and cooking loss. The moisture exhibited differences between the control treatments. C1 was less than C2, because more fat was added in C1 and more water was added in C2. The protein was similar in all the treatments. The fat was similar for all the treatments except C1 treatment where more pork back fat was added. The fat reduction from C1 to the other treatments was near to 50%.

Concerning the emulsion stability, all the treatments were similar, except T1, T2 and T3, showing that fructooligosaccharides added (3% and 6%) reduced emulsion stability and 3% inulin added also reduced emulsion stability. The cooking loss varied from 7.49 to 11.67%, as shown in Table 2. The results showed that the addition of 3% of alpha cyclodextrin and 50% fat reduction produced the smallest cooking loss. The control treatment (C2) with 50% fat reduction and no added fiber had the biggest cooking loss, similar to T5 treatment.

The analyses of texture parameters – hardness and chewiness - of all the treatments are shown in Figures 1 and 2. They show that the addition of the wheat fiber and oat fiber significantly increased the hardness. Results similar to the control treatment with added fat (C1) were obtained with the addition of fructooligosaccharide, inulin and alpha cyclodextrin, with 50% fat reduction. In general,

Table 1. Amounts of Pork back fat and dietary fiber added in each treatment (%)

	C1	**C2**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**
Pork back fat	20	10	10	10	10	10	10	10	10	10	10	10
Fructooligosaccharides	-	-	3	6	-	-	-	-	-	-	-	-
Inulin	-	-	-	-	3	6	-	-	-	-	-	-
Oat Fiber	-	-	-	-	-	-	3	6	-	-	-	-
Wheat fiber	-	-	-	-	-	-	-	-	3	6	-	-
alpha cyclodextrin	-	-	-	-	-	-	-	-	-	-	3	6

when more fibers are added, higher values for hardness are found, but when the alpha cyclodextrin was increased from 3% to 6% smaller hardness values were found. The same results were reported by Ktari et. al [7].

The chewiness had similar results to C1 treatment when 3% of soluble fibers were used (alpha cyclodextrin, fructooligosaccharides and inulin) and 50% fat reduction, or 6% of alpha cyclodextrin and 50% fat reduction.

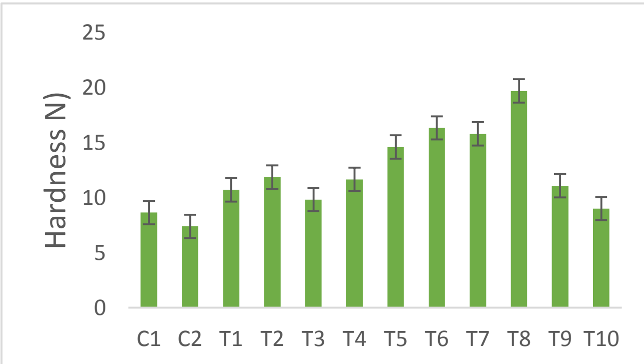

Figure 1. Effects of the added fibers on the hardness of the cooked meat. Data are expressed as mean ± SD (n = 10 replications). Control samples (C1 and C2) were without the addition of fibers.

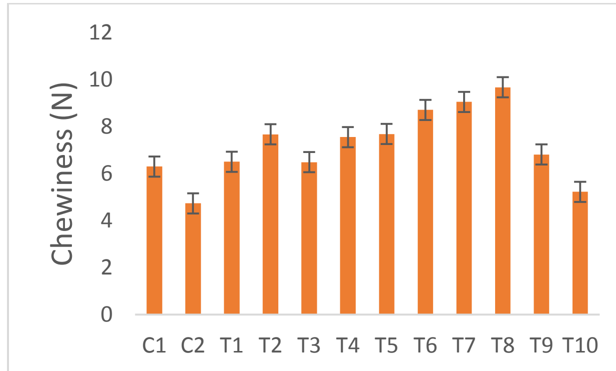

Figure 2. Effects of the added fibers on the chewiness of the cooked meat. Data are expressed as mean ± SD (n = 10 replications). Control samples (C1 and C2) were without the addition of fibers.

Table 2 Mean ± SD of the percentage compositions, the emulsion stability (%) and the cooking loss of the treatments.

Treatment	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Emulsion Stability (%)	Cooking loss (%)
C1	66.90 ±0.38^{g}	10.49 ±0.31^{a}	13.46 ±1.95^{a}	3.56 ±0.10^{a}	98.53 ±0.77^{a}	10.23 ±0.11^{ab}
C2	75.40 ±0.19^{a}	11.10 ±0.54^{a}	7.44 ±0.26^{b}	3.61 ±0.01^{a}	96.98 ±0.16^{a}	11.67 ±0.70^{a}
T1	72.93 ±0.12^{bc}	10.69 ±0.23^{a}	6.88 ±0.38^{b}	3.45 ±0.04^{ab}	85.31 ±0.70^{b}	10.70 ±0.33^{ab}
T2	70.09 ±0.05^{e}	10.87 ±0.16^{a}	6.54 ±0.83^{b}	3.37 ±0.08^{ab}	88.72 ±2.20^{b}	9.34 ±0.15^{bc}
T3	72.71 ±0.04^{bcd}	10.78 ±0.25^{a}	6.90 ±0.35^{b}	3.17 ±0.03^{ab}	88.54 ±1.23^{b}	9.48 ±0.07^{abc}
T4	69.47 ±0.14^{ef}	10.96 ±0.37^{a}	7.34 ±0.39^{b}	3.37 ±0.05^{ab}	99.54 ±0.22^{a}	10.02 ±0.29^{ab}
T5	73.15 ±0.39^{b}	10.42 ±0.22^{a}	7.38 ±0.53^{b}	3.53 ±0.01^{a}	98.97 ±0.32^{a}	11.66 ±0.28^{a}
T6	69.54 ±0.21^{ef}	10.58 ±0.20^{a}	7.04 ±0.45^{b}	3.60 ±0.06^{a}	98.77 ±0.64^{a}	9.32 ±0.79^{bc}
T7	72.39 ±0.08^{cd}	10.68 ±0.17^{a}	7.33 ±0.45^{b}	3.53 ±0.04^{a}	99.79 ±0.03^{a}	9.19 ±0.86^{bc}
T8	69.39 ±0.26^{f}	10.65 ±0.32^{a}	6.93 ±1.15^{b}	3.52 ±0.06^{ab}	99.80 ±0.14^{a}	9.82 ±1.26^{ab}
T9	72.25 ±0.23^{d}	10.84 ±0.34^{a}	7.11 ±0.70^{b}	3.39 ±0.04^{ab}	99.68 ±0.19^{a}	7.49 ±0.18^{c}
T10	68.94 ±0.26^{f}	11.03 ±0.13^{a}	6.55 ±0.59^{b}	3.04 ±0.39^{b}	99.74 ±0.19^{a}	10.5 ±0.36^{ab}

$^{a, b, c, d, e, f, g}$ means in the same column with the same letters did not differ different significantly at 5% level (Tukey´s test) (p≤0,05).

IV. CONCLUSION

The addition of fibers with fat reduction in emulsified and cooked meat product can help in emulsion stability.

The addition of 3% of alpha cyclodextrin and 50% fat reduction had the best result found to cooking loss. The addition of 6% of alpha cyclodextrin and 50% fat reduction had found similar result to C1 treatment to hardness. The chewiness had similar results to C1 treatment when 3% of soluble fibers were used and 50% fat reduction, or when 6% of alpha cyclodextrin and 50% fat reduction.

The results demonstrate that alpha cyclodextrin proved to be an efficient ingredient in the application to emulsified and cooked meat product.

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