EVALUATION OF THE COOKING LOSSES (YIELD AND SHRINKAGE) AND TEXTURE PROFILE IN LOW FAT BEEF BURGER ENRICHED WITH DIETARY FIBERS.

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Abstract – The purpose of this study was to evaluate the effect of dietary fiber as a fat substitute in a restructured meat product – the beef burger. Two soluble dietary fibers (inulin and fructooligosaccharides) and two insoluble fibers (oat fiber, wheat fiber) were used, separately, in the proportions of 3 and 6%. The samples were characterized by determination of moisture content, ash, protein and fat. Cooking losses analysis (yield and shrinkage) and a texture profile were performed. With regard to the chemical composition, the treatments showed no significant difference in the ash and protein content. A reduction in fat of more than 50% was obtained in the treatment compared to the control treatment - C1. The sample with 6% oat fiber had the highest yield and the lowest shrinkage, inversely affecting the hardness parameter. The samples with added soluble fiber showed similar results to sample C2 (with reduced fat) in terms of weight loss during baking (yield). In the texture profile, the use of soluble fiber produced a decrease in hardness when compared to the control treatments.

Key Words – Fat substitute, soluble and insoluble fibers, Restructured meat product

I. INTRODUCTION

The increased demand for healthy meat products with reduced fat content is stimulating the development of innovative and reformulated foods with reduced fat content, cholesterol and calories, and also the introduction of fatty acids with altered profiles. In this context, the beef burger is one of the most frequently used products for testing fat replacement [1].

Fat is an essential component in meat and meat products, responsible for such quality characteristics as juiciness, texture, meaty flavor, cooking yield and characteristic aroma [2]. However, excessive fat intake is associated with various diseases including obesity, cancer and coronary heart disease [3, 4]. Maintaining a high water retention capacity, good texture and attractive sensory attributes in meat products with reduced fat is a challenge. [5]

Various types of fibers have been used in meat products, as fat substitutes [6, 2, 7, 8] to increase the cooking yield due to their water and fat binding properties and to improve texture [9].

The consumption of meat products with added dietary fiber can contribute to the prevention of diseases like coronary heart disease, diabetes, irritable bowel disease, obesity. Fiber may also alter serum concentration of hormones or short chain fatty acids that affect lipid metabolism [10].

At present there is no single ideal fat replacer that can recreate all the functional and sensory attributes of fat. Therefore, a detailed study in the area of meat products with added dietary fibers as a fat substitute is needed. Thus, the objective of this study was to evaluate the influence of adding 3 and 6% of 2 soluble (fructooligosaccharides and inilun) and 2 insoluble (oat fiber and wheat fiber) dietary fibers in beef burgers with fat reduction, on the physicochemical parameters, texture profile and cooking losses (yield and shrinkage).

II. MATERIALS AND METHODS

The raw material used was ground beef burgers Front beef (sparerib and palette) and pork fat (backfat). Two soluble dietary fibers were used (Orafti® inulin - Clariant and fructooligosaccharide of Ingredion® and two insoluble fibers (JRS Rettenmeyer® oat fiber and Nutrassim® wheat fiber). In the production of the ten treatments, all the ingredients were weighed, mixed and molded with the aid of a hamburger press. Then they were frozen individually. The samples were kept in the freezer at -18 ° C during the analysis. All treatments used the following ingredients: 70% beef; 1.5% salt; 12.05% sodium

erythorbate; 12.15% monosodium glutamate; 0.2% white pepper and also ice in the required amount to complete 100%. Table 1 shows the amounts of pork back fat and dietary fiber added in each treatment.

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

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

* fructooligosaccharide

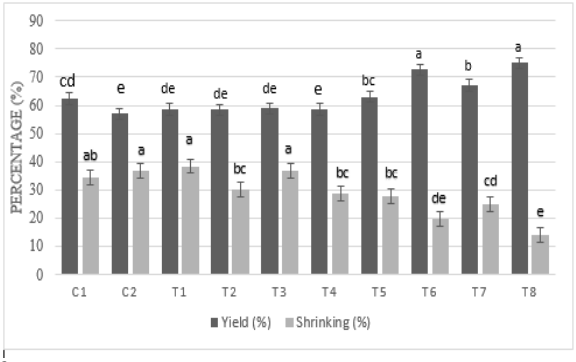
The treatments were characterized for moisture, protein, and ash content according to AOAC [11] and the fat content was determined according to the Bligh & Dyer's method [12].

The cooking yield and percentage of shrinkage were measured, according to Berry [6] and changes proposed by Seabra *et al.* [13]. The analysis of texture profile (TPA) was performed on the baked sample after 15 days of storage under freezing, using a TA-XT2i Texture Analyzer (Stable Micro Systems, Haslemere, Surrey, England), and the parameters evaluated were: hardness, cohesiveness, springiness and chewiness. Statistical data were analyzed using analysis of variance (ANOVA), and the difference between the mean values were evaluated using the Tukey test, at a confidence level of 5%.

III. RESULTS AND DISCUSSION

Figure 1 shows the results of weight loss (yield) and the reduction in diameter (shrinkage) during cooking. Sample C2 had the lowest yield in comparison to the other samples due to its lower amount of added fat and the absence of fibers. The samples with added soluble fiber (T1, T2, T3 and T4) showed no significant difference ($p < 5\%$) when compared to the control sample C2, which indicates that the addition of such fibers does not significantly affect the yield.

Figure 1- Cooking loss of the treatments.



[a]means different letters indicate statistically significant differences between samples using Tukey test ($p \leq 0,05$).

The samples with the highest yields were T6 and T8. The T5 and T7 samples also showed high yields. This indicates that the addition of the insoluble fibers studied positively affected the yield of the treatments, reaching almost 74%, probably due to their good binding capacity with water. Mansour [14] also found that, in beef burgers, the addition of different types of wheat fiber significantly decreased loss during cooking due to the high water binding capacity of wheat fiber.

The opposite effect is observed in the shrinkage of the samples after cooking, and the samples enriched with insoluble fiber (wheat fiber, oat fiber) had a significantly lower shrinkage ($p > 0.05$) than C1, C2 and the treatments with the soluble fiber. Table 2 shows the chemical composition of the treatments, and shows that the treatments did not differ significantly ($p > 0.05$) for ash and protein, because the amount of meat used is the same between treatments. The difference observed in the analysis of water content can be justified in terms of the different amounts of ice added in each formulation, which was adjusted as previously mentioned. In relation to fat content, there is a reduction of over 50% compared to sample C1 with the other treatments.

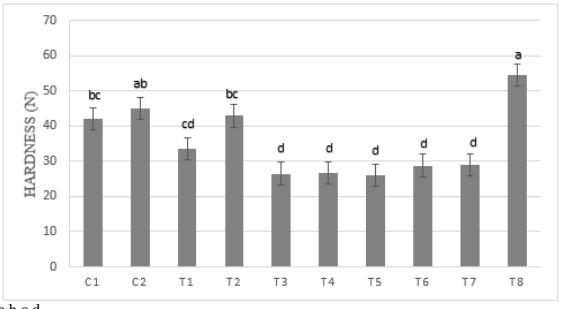
Table 2- Mean ± SD of the composition of the treatments. (%).

Treatments	Moisture	Ash	Protein	Fat
C1	63.59 ± 0.681^{d}	2.25 ± 0.047^{a}	15.12 ± 0.048^{a}	12.86 ± 1.087^{a}
C2	70.56 ± 0.262^{a}	2.17 ± 0.009^{a}	15.29 ± 0.098^{a}	5.76 ± 0.708^{b}
T1	67.03 ± 0.781^{abcd}	2.20 ± 0.066^{a}	15.43 ± 0.046^{a}	6.18 ± 0.806^{b}
T2	64.75 ± 0.416^{cd}	2.09 ± 0.051^{a}	16.12 ± 0.002^{a}	5.65 ± 0.351^{b}
T3	68.66 ± 0.095^{ab}	2.19 ± 0.115^{a}	15.79 ± 1.219^{a}	5.64 ± 0.687^{b}
T4	65.61 ± 0.539^{bcd}	2.03 ± 0.014^{a}	16.80 ± 0.162^{a}	5.95 ± 0.796^{b}
T5	66.99 ± 0.342^{abcd}	2.11 ± 0.031^{a}	15.34 ± 0.679^{a}	5.68 ± 0.395^{b}
T6	65.16 ± 0.927^{bcd}	2.05 ± 0.035^{a}	16.42 ± 0.463^{a}	5.67 ± 0.386^{b}
T7	67.76 ± 0.316^{abc}	2.14 ± 0.033^{a}	15.32 ± 0.126^{a}	5.73 ± 0.386^{b}
T8	64.22 ± 0.596^{cd}	2.23 ± 0.041^{a}	16.07 ± 0.129^{a}	6.33 ± 0.859^{b}

^{a,b,c,d}means that different letters in the same colunn indicate statistically significant differences between samples using the Tukey test ($p \leq 0.05$).

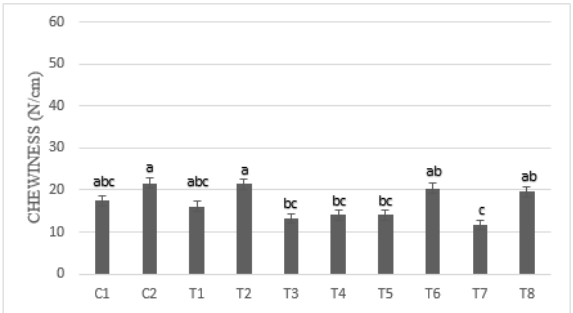
Figure 2 illustrates the results to hardness and Figure 3 illustrates the chewiness. There was no significant difference for cohesiveness and elasticity ($p > 0.05$), indicating that the addition of fiber to beef burgers with fat reduction, does not affect these latter parameters.

Figure 2- Hardness of the treatments.



^{a,b,c,d}means that different letters indicate statistically significant differences between samples using the Tukey test ($p \leq 0.05$).

Figure 3- Chewiness of the treatments.



^{a,b,c,d}means that different letters indicate statistically significant differences between samples using the Tukey test ($p \leq 0.05$).

Changes in fat content significantly affected the textural characteristics of meat products as was reported by Cavestany *et al.* [15] during studies conducted with sausages.

In the results obtained by Mendoza et al. [8] the addition of inulin in to low-fat, dry-fermented sausages had no effect on the hardness of the samples, which remained similar in all treatments.

IV. CONCLUSION

Dietary fiber can replace fat in beef burgers and may have some advantages for yields and loss by shrinking, especially the insoluble fibers. The wheat fiber and oat fiber when used in a proportion of 6% showed higher yields, lower shrinkage and higher hardness, when compared to the control samples.

ACKNOWLEDGEMENTS

The authors thanks the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for their financial support and the Frigorífico Olhos D'água for the donation of the raw material.

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