PE4.82 Microbial Transglutaminase Effects on Texture Properties of Low Salt Meat Emulsions 286.00

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***Abstract*— The effect of microbial transglutaminase (MTG) on low salt meat emulsions prepared with olive oil was studied. Six formulations were manufacturated combining different concentrations of NaCl, KCl, soy protein isolated and caseinate. Apparent viscosity, cooking loss and texture profile analysis (hardness, springiness, cohesiveness and chewiness) were determined at 24 hours. Samples with MTG increased apparent viscosity and texture parameters. In general, combination MTG/caseinate/KCl provides the best results on texture profile. In conclusion, Microbial Transglutaminase enables to obtain low salt meat emulsions with olive oil, keeping and even improving texture profile. This may be a useful tool to investigate and develop new healthy meat products.**

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***Keywords:* caseinate, low sodium, microbial transglutaminase, olive oil, texture.**

I. INTRODUCTION

The importance of the link between nutrition and health becomes more and more a hot topic. LDL cholesterol and blood pressure are well-established markers for risk assessment of cardiovascular disease.

Olive oil has very novel beneficial effects on postprandial lipid metabolism and thrombosis [1]. Habitual dietary olive oil consumption was associated with more efficient postprandial lipid metabolism and an attenuated thrombotic response. Furthermore, dietary substitution of MUFA, derived from olive oil, for saturated fat improved postprandial lipid metabolism and thrombosis and significantly reduced plasma cholesterol concentrations. Few researches have been refered to the use of olive oils as substitute of pork backfat in meat emulsions [2].

Sodium intake and the link to blood pressure is generally accepted. Higher blood pressure increases the risk of cardiovascular disease. LDL, HDL cholesterol and triacylglycerol levels in blood are directly linked to quantity and quality of fat in the diet. Meat products contribute to salt and fat intake in the diet.

The actual sodium intake exceeds the nutritional recommendations (max. 6 g/person) in the western world. NaCl affects flavour, texture and a_w (shelf life) of processed meat products. Solubilization of myofibrillar proteins by NaCl is important for texture, gel formation, water and fat binding capacity. Food safety will determine the level of salt decrease rather than technological or flavour issues. All salt replacers with a similar effect on a_w have a decreasing effect on flavour in comparison to common salt. The main source of Na+ is common salt (NaCl). Reducing Na^+ in meat products can be done by replacing NaCl by other salts, such as KCl and $MgCl^2$. Replacing Na^+ by K^+ or Mg^{2+} is limited due to the introduction of a bitter taste. Better results are obtained with mixtures of different mineral salts.

As sodium salt influences texture characteristics it also influences texture related flavour characteristics, besides NaCl is also important for the decrease of water loss during cooking. If lowering sodium content goes together with a reduced fat content, this could cause problems due to the decreased ionic strength (replacement of the fat by water).

Transglutaminase has been proposed as a useful tool to induce gelification of muscle protein that reduces or eliminates the need to add NaCl [3] [4], improving the textural and water-holding properties of food proteins. Besides, TGase in combination with non-meat proteins (among them caseinate) could be used successfully in beef and poultry patties as direct replacers of NaCl and tripolyphosphate salts [5].

Therefore, the objective of the present study was to compare the effects on texture properties of combinations of TGase with various non-meat ingredient (caseinate, KCl) as salt replacers.

II. MATERIALS AND METHODS

2.1. Meat emulsions formulation and processing

The main effects investigated were: MTG level (0 g/100 g and 0.3 g/100 g) and modification of the formulation (different concentrations of NaCl, KCl, soy protein isolated, caseinate and emulsified/ non-emulsified olive oil). For this, 6 formulations described in table 1, were prepared in duplicate. In one batch (MTG-0.3), 3g/1000g of MTG was added. In the other batch (MTG-0), used as control, 0g/1000g of MTG was added. MTG, (Ajinomoto, Barentz, Poland) was a mixture containing 99% maltodextrin and 1% MTG (activity of ~ 100 units/g). The enzyme concentration as reported in the present study is the concentration of the commercial product.

2.2. Apparent viscosity and pH

The apparent viscosity of solutions was measured at 24h in fresh, using Haake viscometer, Model Viscotester 7R (Thermo Fisher Scientific, Inc., Madrid, Spain). Viscometer readings were recorded at six different rotational speeds (5, 10, 30, 40, 50 rpm). All data were taken after 90 s in each sample. The temperature was kept constant at 20 °C using a thermostatically controlled water bath.

The pH of solutions was determined in duplicate, at 24h in fresh meat emulsions, using a pH meter (Crison basic GLP 22,Barcelona, España).

2.3. Cooking loss

Cooking loss of meat emulsions was calculated as weight loss during heat processing and expressed as % of initial sample weight.

2.4. Texture profile analysis (TPA)

Texture profile analysis (TPA) was carried out at room temperature (20-22 °C). TPA was performed using a TA.XT2i SMS Stable Micro Systems Texture Analyser (Stable Microsystems Ltd., Surrey, England) with the Texture Expert programme.

In general, two cubes of side 10mm were prepared from every sample. A double compression cycle test was performed up to 50% compression of the original portion height with an aluminium cube probe of 2 cm side. The following parameters were quantified [6]: hardness (N) maximum force required to compress the sample, springiness (mm), ability of the sample to recover its original form after deforming force was removed, cohesiveness (dimensionless), extent to which the sample could be deformed prior to rupture and chewiness (N mm), hardness x cohesiveness x springiness.

2.5. Statistical analysis

The experiment was replicated three times. Each parameter was determined two times in each sample. Data shown in the tables are the means and standard errors of the mean (SEM). Analysis of variance (ANOVA) and a Tukey's a posteriori test were used to determine significant differences ($p \leq 0.05$) among the different types of meat emulsions. All statistical analyses were computed using SPSS software (SPSS V. 15.0, SPSS Inc. USA).

III. RESULTS AND DISCUSSION

3.1 Apparent viscosity and pH

Apparent viscosity was affected ($p \leq 0.001$) by formulation and treatment with MTG (Table 2). The addition of MTG to the six formulations resulted in a increase in viscosity except in F3. The best improvement was observed in formulations with caseinate (F5, F6), resulting the highest values of viscosity. Caseinate has proven to be a good substrate for MTG [3] [7].

Samples MTG-0.3 presented a pH slightly lower (6.227) than samples MTG-0 (6.353).

3.2. Cooking loss

Cooking loss was lower in the samples with caseinate (F5 and F6). In general, samples with KCl had a higher cooking loss due to the presence of this cation [8].

Many studies describe that addition of MTG increase the water retention in pork and beef [9], although in this study cooking losses were higher in samples with MTG (Fig1). This may be partially explained by differences in type of protein, level of MTG used [10] and the conditions of use (reaction temperature and time, meat particle size and disruption methods, presence of other ingredients, meat source, etc.) [11]. Besides there is evidence that the effect of the MTG may be influenced by the meat species [11] [5] [12].

3.3 Texture profile analysis (TPA)

TPA indicated that MTG addition increased all parameters quantified ($p \leq 0.001$), improving the texture properties (Fig.2) This result is similar to the obtained in pork gels [13].

Combination of MTG with caseinate and KCl (F6) presented the highest increasement in hardness, springiness and chewiness (Fig.6) Therefore, this combination of non-meat ingredients in a low salt meat emulsion improve texture [7].

IV. CONCLUSION

Transglutaminase treatment (MTG-0.3) provides new opportunities for extending the range of functional properties in meat systems with olive oil. Moreover a right combination of MTG with caseinate as non-meat protein, KCl as salt replacer and olive oil as pork backfat substitute, may be used to obtain low salt meat emulsions with improved physiochemical and nutritional properties. This is of great interest to the meat industry as actual society demands healthy products.

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Table 1: General formulation (g/100g) of the different samples[a].

Formulation MTG-0 [b] / MTG-0.3 [b]	Turkey meat	NaCl	KCl	Caseinate	Emulsion[c]	Soy protein isolate	Olive Oil	Water
F1	45	2	0	0	1	0	0	51,5
F2	45	1	1	0	1	0	0	51,5
F3	45	2	0	0	0	1.5	5	46
F4	45	1	1	0	0	1.5	5	46
F5	45	2	0	1.5	0	0	5	46
F6	45	1	1	1.5	0	0	5	46

[a] All samples also contain 0.02% Na NO_3 and 0.08% Sodium Ascorbate.
[b] MTG-0: formulation without transglutaminase; MTG-0.3 : formulation with 0.3% comercial microbial transglutaminase mixture (ACTIVA WM).
[c] Composition of emulsion: soy isolate:water:olive oil in proportion 1:8:10

Table 2: Apparent viscosity (MPa) measured at 24h in fresh meat emulsion of different samples [a].

FORMULATION	MTG-0	MTG-0.3
F1	14045.46 [ab]	21939.75 [ab]
F2	14718.37 [ab]	18355.15 [b]
F3	28514.36 [c]	22799.32 [ab]
F4	17386.63 [a]	24610.41 [ab]
F5	12349.33 [b]	49969.31 [c]
F6	13689.71 [b]	27094.05 [a]
ERROR (SEM)	873.57	1704.23
Sig	***	***

[a] For sample denomination see Table 1. Means with different letters in the same column are significantly different (P < 0,05). SEM: standard error of the mean. MTG-0 = samples without transglutaminase; MTG-0.3 = samples with microbial transglutaminase 0.3%.

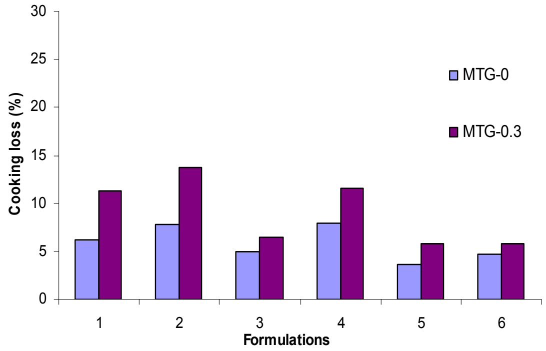

Fig. 1:Effect of differents formulations and MTG on cooking loss. MTG-0 =samples without transglutaminase ;MTG-0.3= samples with microbial transglutaminase 0.3%.

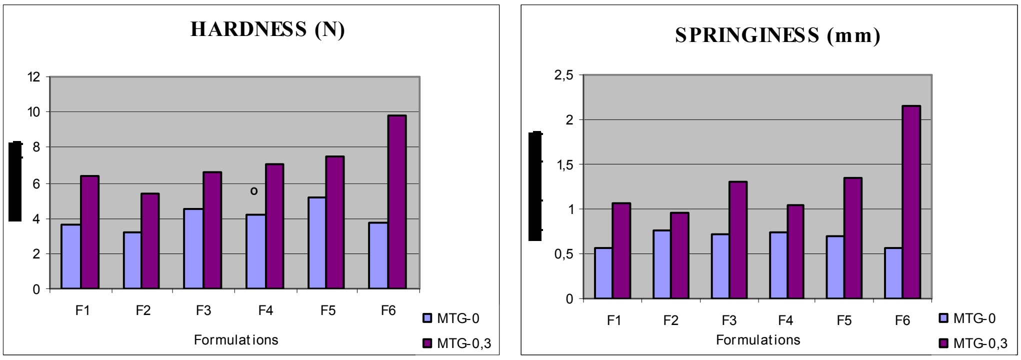

Fig. 2 Effect of MTG and formulation on TPA parameters (hardness, chewiness,springiness and cohesiveness).