6:3

UTILIZATION OF CARRAGEENAN IN THE MANUFACTURE OF HAMS.

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SUMMARY

Four different carrageenan were evaluated: i) Kappa carrageenan with different levels of 3-6 anydro-galactose and 30% locust gum; ii) a mixture of pure carrageenans; iii) 100% Kappa carrageenan and iv) a mixture of 60% Kappa carrageenan, 30% locust gum and 10% calcium lactate.

Molded hams were prepared at pilot plant scale with 35% added pickle, including 0,3% carrageenan.

Weight losses were determined and textural properties measured in an Instron machine. Sensory evaluation included appearance, texture and flavor by a 7-point scale.

Cooking losses were not affected by carrageenan type, but the method of application had a significant effect, injection and massage giving 2,2% less cooking loss.

No significant differences were observed between carrageenan types for instrumental texture measurements or sensory evaluations.

Sensory evaluation of texture did give significantly different results (P<0,05) though, for the different manufacturing methods, a) injection and massage, receiving an average score of 5,65 and b) massage, 5,2 on the 7-point scale.

INTRODUCTION

"Carrageenan" is a generic term applied to a group of thickening and gelling agents (gums) extracted from red seaweeds. As agar, carrageenans are polysaccarides and do not contain proteins. They can correspond to one of three main types or fractions: Kappa, iota and lambda. However, commercial products are mixtures of these types of carrageenans to which other types of gums may be added, such as locust bean gum and guar gum in the form of sodium, potassium and calcium salts. The Kappa and iota types can be commercially obtained virtually pure (Perdersen 1977; Graham 1973; Christonsen et al 1980; Anonimous 1983).

In cured meat products the effect on water retention produced by additives such as salt and phosphates is well known. However water retention levels reached by this method are not satisfactory when high volumes of pickles are injected. Gelling agents keep to increase the water retention being particularly effective during the cooking process in order to reduce shrinkage. The gelling capability of carrageenans make them particularly fit for this purpose.

The objective of this paper is to appraise the effect of different commercial carrageenans on the yield and texture of pressed hams, as well as to evaluate the influence of the method of application of brine in the process.

MATERIALS AND METHODS

Four commercial carrageenans were evaluated and tested :

A- Combination of two types of carrageenans with different levels of 3-6 anhydro-galactase and 30% locust bean gum.
B- Pure carrageenans mixtures.
C- 100% Kappa carrageenans.
D- Mixture of 60% Kappa carrageenans, 30% locust bean gum and 10% calcium lactate.

Gel strength (g/cm^2) was determined in an Instron Food Testing Machine, Mod 1140, on a gel with 1.5% carrageenan at 20°C, using a stem of 1 cm^2 cross-sectional area and a 5 Kg load cell. Cross head speed was 50 mm/min.

Viscosity (cp) was measured with a Brookfield LVT viscometer, in 1,5% carrageenan at 80°C, with spindle N°1 at 12 r.p.m. Weight loss by desiccation (%), was determined in a gravity convection oven oven, at 105°C until constant weight and ash content by the AOAC method (AOAC, 1980).

pH was measured in agenous dispersion, with a PHM-62 ph meter (Radiometer, Copenhagen).

Pressed hams were prepared at pilot plant scale, following one of two alternative procedures.
a) Multineedle injection and massaging.
b) Massaging with added brine.

Injection was carried out in a Junior BI-18 multineedle injectar (Inject Star, Wien) to 35% weight increase on green weight, with "light" brine (without addition of starch or any other thickening agents, except carrageenan), containing 8,2% salt, 2% sugar, 2,5% phosphates, 0,13% sodium nitrite and 0,3% carrageenan.

Massaging was carried out in an A68X vacuum massager (Cimber Staal, Copenhagen).

Far process a) meat was cut in large pieces, to get a more effective injection, whereas in process b) it was cut in small pieces to improve brine absorption during massaging.

In both processes, the meat was massaged twice with vacuum, for 60 minutes each time, once at the beginning of the 24 hour curing process and again at the end. Four replicates were made of each of the 8 treatments studied.

RESULTS AND DISCUSSION

Table 1, shows the results of chemical analysis of the carrageenans.

Carrageenans A and D behaved similarly as expected, since they both contain locust bean gum. With these carrageenans opaque gels were obtained with little syneresis.

Carrageenan B gave the lowest gel strength : 483 g/cm^2. This may be due to carrageenan B being a mixture of pure carrageenans (Kappa, iota, lambda). It is known that pure Kappa carrageenan has several disadvantages, among which gel syneresis is worth noticing. However, this defect can be overridden by the addition of iota carrageenan, with a higher water holding capacity, at the expense of lowering gel strength. Gel cohesiveness, however, increases. (Rassmussen, 1972; Pedersen, 1977).

Carrageenan C being 100% Kappa carrageenan, shows a high gel strength (765 g/cm^2) as compared with carrageenan A and D, which have locust bean gum added. It is worth noticing that carrageenan C did not show marked gel syneresis, as indicated in literature reports for Kappa carrageenans (Pedersen 1977, Anonymous 1985). Rassmussen, (1972), however, tested 4 Kappa carrageenans from 4 different red seaweeds obtaining gels of different texture with the same concentration of carrageenan, concluding that carrageenans from different origin, methods of obtentions, may present small deviations from the ideal structure so that their behaviour may change.

Table 1.- Physical-chemical analysis of carrageenans tested

Parameters	Carrageenans type A	B	C	D
Gel strength (g/cm^2)	822	483	765	790
Weight loss by desiccation (%)	9,8	6,5	9,63	9,0
Ash (%)	23,5	12,75	29,1	28,5
Viscosity (cp)	22	31	24	27
Ph	6,21	8,21	7,84	6,96
	Muddy gel with little synerests	Transparent gel with marked synevesis.	Opaque gel with little syneresis	Opaque gel with little syneresis

Table 2.- Percentage cooking loss. Mean values.

Process \ Carrageenan type	A	B	C	D	$\bar{X}$	Significance
Injection massage	14,217	12,262	15,512	11,807	13,449	
Massage	16,371	15,608	15,134	15,339	15,613	*
$\bar{X}$	15,294	13,935	15,323	13,573	-	N.S.

Table 2 shows the result of statistical analysis of cooking losses. No significant differences were found among carrageenans. However the effect of the curing method was significant at $p < 0.05$ under our experimental conditions. These results agree with previous literature reports stating that carrageenans are more effective in reducing cooking losses applied with brine into muscle through injection (Anonymous, 1985; Cortés, 1985; Orovio et al, 1982).

Although the non-significance of carrageenan type as regards cooking losses is in conflict with literature reports, it must be born in mind that in the case of solid and semi-solid forms. The situation is more complex than in simple, aqueous systems.

Most of the published research results have been obtained in systems of the latter type (Alvarí, 1982).

Table 3.- Texture measurements in the finished products. (Kgf).

Process \ Carrageenan type	A	B	C	D	$\bar{X}$	Significance
Injection-massage	133,25	126,67	125,75	132,12	129,45	N.S.
Massage	123,80	126,50	137,85	124,65	129,45	
$\bar{X}$	128,52	126,58	131,88	130,88	-	N.S.

Table 4.- Sensory evaluation of texture. 7 point scale.

Process \ Carrageenan type	A	B	C	D	$\bar{X}$	Significance
Injection - Massage	5,5	5,6	6,0	5,5	5,65	N.S.
Massage	5,2	5,4	5,5	4,7	5,2	
$\bar{X}$	5,3	5,5	5,75	5,1	-	N.S.

Very little, if anything, has been published on the performance of carrageenans in heterogeneous systems such as meat.

The statistical analysis of instrumental and organoliptic measurements of texture are summarized in Tables 3 and 4.

No significant differences were found either among carrageenans or curing methods.

These results may be due to the levels of carrageenans used. A level of 0,1-0,6% carrageenan, calculated on a fresh product basis is generally recommended but the level actually required depends on specific conditions including type of product, desired performance, quality of raw meat, concentration of salt, other additives, ph, etc.

In our case a level of 0.3% of carrageenans in the brine was used, which at 35% infection gives a level in the final product of 0.12%. This is probably too low to have a significant effect on texture, either according to instrumental or sensory measurement.

CONCLUSIONS

1.- No significant effect, either on cooking losses or texture, was observed when four different commercial carrageenans were used in the manufacture of pressed ham.

2.- Hams cured by an injection-massaging method showed cooking losses were significantly lower ($p<0.05$) than those of hams cured by a massage method.

BIBLIOGRAPHY

1.- Alvarí, P. (1982) Personal communication.

2.- Anonymous (1985) "Carragenina en productos procesados de carne" . The Copenhagen Pectin Factory LTD Denmark.

3.- Anonymous (1983) "Food Aditives" . Food Technology Review No. 58 Vegetable Gums. Noyes . Park Ridge.

4.- A.O.A.C. (1980) Official Methods of Analysis of the Association of Official Analytical Chemists. 13th Ed. A.O.A.C. Washington, D.C.

5.- Christensen, O. and Trudsoe, J. (1980) "Effect of other Hydrocolloids on texture of Kappa Carrageenan Gels" J. Text. Stud. 11 (2), 137-147.

6.- Cortes, H. (1985) Personal communication.

7.- Graham, H. D. (1977) "Food Colloids", 323-328 ; AVI, Westport.

8.- Orovio, L; Ramos, M.; Guerra, M.A. Unpublished results.

9.- Pedersen, J.K. (1977) "La carragenina en productos cárnicos gelificados" Revista Afinidad. 34 ; pag. 637-642.

10.- Rasmussen, J. (1972) "Variation and characterization of gel texture produced by carrageenan. Parte I. Textures of water gels of Kappa carrageenan" . 15th C.I.F.S.T. Meeting Toronto.