COLOURIMETRIC CHARACTERIZATION OF MEAT EMULSIONS CONTAINING ALBEDO

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BACKGROUND

Nowadays there is an increasing demand of low-fat meat products. Developed countries have experienced emerging pathologies related to fat consumption and consequently health concerns and consumer demands have motivated a growing interest in fat substitutes (Chin *et al.*, 1999; Lyons *et al.*, 1999; Kerry *et al.*, 1999). Formulating low or fat free meat products provides multiple challenges to the meat industry. Fat has a considerable influence on the sensory characteristics and texture of the product. The objective of this search is to decrease calorie content of meat products maintaining sensory characteristics by means of appropriate formulations, directed also to reduce certain lipids, such as saturated fatty acids and cholesterol (Boatella *et al.*, 1993). Citrus fibre, albedo, is an ingredient with possibilities as a partial fat-replacer.

OBJECTIVE.

The aim of this work was to study the colour (CIEL*a*b *) of a meat emulsion containing different percentages of citrus fibre (albedo) and to determine the influence of this ingredient on the product.

MATERIALS AND METHODS.

Raw matter: Veal cuts used were: lean, chop and dewlap. They were cut, packed, weighed and frozen The albedo was obtained from lemons of the variety Verna. The albedo was chopped, packaged and frozen for later use. Before use, part of the albedo was cooked.

Bologna sausages manufacture: The sausages were manufactured following traditional formula except for the exclusion of colorants to observe colour variations. Combinations of two meat formulations: lean: chop: dewlap (20:40:60) and (40:40:20), five percentages of albedo addition: 0, 2,5, 5, 7,5, 10 and two types of albedo: cooked and raw, gave a total of 20 different formulas.

Colour determinations: The study of the colour was carried out according to the recommendations of the American Science Association (Hunt *et al.*, 1991), carrying out 9 determinations in each sample. The determinations were carried out directly on the product. The colour measures were made using the colorimeter Minolta CR-10 (Minolta Camera Co. Osaka, Japan). In all determinations low reflectance glasses Minolta CR-A51/1829-752 (Minolta Camera Co. Osaka, Japan) were used between the samples and the equipment (Hunt *et al.*, 1991). The studied colour parameters were the coordinated lightness (L*), redness (a*) and yellowness (b*) of the CIEL*a*b* colour space.

Statistical analysis: Statistical analysis of the variance (ANOVA) with three factors were applied: meat proportion (two levels: 2:4:4 and 4:4:2), fibre percentage (five levels: 0%, 2,5%, 5%, 7,5%, 10%) and fibre type (two levels: raw and cooked) and the Tukey test was applied (Gómez & Gómez, 1976; Afifi & Azen, 1979; Gacula & Singh, 1984). All the analyses were carried out by means of the statistical package Statgraphics Plus for Windows, version 2.1 (Statical Graphics Corp., Rockville, USES).

RESULTS AND DISCUSSION.

The results of the ANOVA of the effects of fibre addition on colour parameters are presented in Table 1. The Tukey test for the variables that were significantly affected is presented in Table 2.

Table 1. - Results of the statistical analysis ANOVA carried out for the studied colour variables.

VARIABLE	FACTOR	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P-VALUE
L*	Meat formula	24.9185	1	24.9185	10.43	0.0013
	Percentage fibre	26.0815	4	652.038	273.01	0.0000
	Fibre type	210.313	1	210.313	88.06	0.0000
a*	Meat formula	88.4116	1	88.4116	101.35	0.0000
	Percentage fibre	1567.14	4	391.784	449.12	0.0000
	Fibre type	0.01157	1	0.01157	0.01	0.9083
b*	Meat formula	0.024	1	0.024	0.06	0.8124
	Percentage fibre	43.5836	4	10.8959	25.60	0.0000
	Fibre type	0.096	1	0.096	0.23	0.6350

Lightness (L):* The three studied factors (Table 1) significantly affect lightness ($P < 0.01$). The lightness of meat products, depends on water holding capacity, pH, myoglobin concentration, moisture and fat content (Hunt *et al.*, 1991; Fernández-Ginés, 1998; Onyango *et al.*, 1998; Pérez-Álvarez *et al.*, 1998) as well as on the technological treatments applied (García-Marcos, 1996, Fernández-López, 1998, Pérez-Álvarez *et al.*, 1999). In the Tukey test (Table 2) it is observed that lightness increased with fibre addition until 5% albedo is reached, it stops and even decreases when albedo is increased till 10% to values close to those of 0% albedo. This could be explained by the white-yellow component of albedo, imperceptible at low concentrations of albedo in the emulsion but increasing impact in final colour at high concentrations.

Fat content, determined by the meat formula also affected lightness. The cooked albedo loses a great part of its colouring power giving smaller lightness that when using the raw fibre.

Table 2. - Results of the Tukey test for each one of the colour variables regarding the fibre percentage.

FIBRE PERCENTAGE	L*	a*	b*
1	47.10b	17.42c	8.03a
2	49.54d	13.63b	8.6b
3	52.45e	12.47a	8.9c
4	48.16c	13.6b	8.4b
5	46.15a	13.5b	8.5b

a-e For each variable, means within the same column with different superscripts differ significantly ($P<0.05$)

Redness (a):*. Meat formula and fibre percentage significantly affected redness ($P<0.01$), not being affected by the type of fibre ($P>0.05$) Table 1. In general, albedo addition diminishes the component a* with very few differences between different concentrations of fiber, that could be due to a reduction of redness caused by the white component of the albedo, the smallest redness was observed when 5% albedo was used

Yellowness (b):* The only factor that significantly affected yellowness was fibre percentage ($P<0.01$) Table 1. The rest of the studied factors were not significant ($P>0.05$). When carrying out the Tukey test (Table 2), it can be observed that the b* values slightly increased regarding to the control having a maximum value in 5% fibre addition. This could be due to the yellow component of the albedo which contributes to increase the values of b*, independently of the percentage of fibre added.

CONCLUSIONS.

The albedo incorporation increased lightness (L*), yellowness (coordinate b*) and it diminished redness (coordinate a*). The factor type of fibre (cook-raw) only affected the variable L*. The different proportions of lean and fat did not affect the coordinate b*. The addition of 5% fibre presented the best colour results.

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