THE INFLUENCE OF PORK MUSCLE'S TYPE AND ADDITION OF PIGMENT CCMP ON THE COLOUR OF ME[AT] EMULSION COAGULATES

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ABSTRACT

The aim of the work was to investigate the influence of muscle's type and cooked cured meat pigment (CCMP) addition on the colour of m[eat] emulsion coagulates. There were chosen white (*m. longissimus dorsi* = LD) and red (*m. quadriceps femoris* = QF) pork muscles in which [the] content of myoglobin was determined. Meat emulsions were made from these two different muscles and with two different concentrations [of] synthesized pigment in three repetitions. Emulsions with fixed concentrations of nitrite salt and emulsions without any additive for col[our] development were prepared as a comparison in three repetitions, too. It was found that the muscle's type as well as the addition of CCMP ha[d] significant influence on coagulates' colour which was determined with the sensory and instrumental analysis. Coagulates with added nitrite [salt] were evaluated with the highest score for overall acceptability due to their significantly better characteristic pink colour and flav[our] irrespective of used muscle's type. Overall acceptability of coagulates made from LD and with CCMP, was scored significantly better th[an] coagulates made from QF, irrespective of the amount of CCMP added. In general, coagulates made from LD were more light (L-values) a[nd] less yellow (b-value) than corresponding coagulates made from QF.

KEY WORDS: pigments, CCMP, meat, pork meat, colour

INTRODUCTION

The preformed cooked cured meat pigment (CCMP) synthesized directly from bovine red blood cells or through a hemin intermediate w[as] found to be a viable colorant for application to comminuted pork as a nitrite substitute. (Shahidi and Pegg, 1990).

The colour of comminuted muscle foods (from different species) with different content of native mioglobin treated with different levels of preformed cooked cured meat pigment and sodium nitrite after heat processing was examined (Shahidi and Pegg, 1991). However, [the] influence of pork muscle's type and addition of CCMP on the colour of meat emulsion coagulates has not been evaluated. Therefore [the] objectives of this work were to study the effect of two different pork muscles (white or red) and two addition levels of CCMP on the colo[ur] of meat emulsion coagulates.

MATERIALS AND METHODS

All chemicals and solvents used in this study were reagent or food-grade. CCMP was prepared from bovine hemin chloride (Sigma Chemi[cal] Co., USA) as described by Shahidi and Pegg, 1993. There were white (*m. longissimus dorsi* = LD) and red (*m. quadriceps femoris* = Q[F]) pork muscles of normal quality (pH_{LD}=5.54, pH_{QF}=5.97) chosen in which the content of myoglobin was 0.723 and 1.768 mg/g, respective[ly] (determined as described Trout, 1991).

Samples of meat emulsion coagulates differed in the muscle used (LD or QF) and in the addition level of CCMP (synthesized from 120 mg [or] 60 mg of hemin). As a comparison we prepared also emulsions with 1.7 % nitrite salt and emulsions without any additive for colo[ur] development. Thus we made 8 groups of emulsion coagulates (each group in 3 repetitions) which differed in the additives as shown in table 1.

Meat emulsions were prepared from:
560 g meat, 170 g pork back fat, 200 g ice, 3 g Na-polyphosphate, 550 mg Na-ascorbate and 50 ml 2 % (w/w) ascorbic acid in which CCMP was dissolved.
Emulsions were prepared in the cutter Stephan UMC 5 electronic, which was connected to a vacuum pump Hanning Elektro Werke VDE 0530. A vacuum of approximately 80 % was achieved. We mixed emulsions at 3000 min^{-1} till they reached the temperature of 14°C.

Table 1 Groups of prepared emulsion coagulates

Abbreviation	hemin (mg)	NaCl (g)	nitrite salt (g)
120LD	120	17	
60LD	60	17	
NLD			17
WLD		17	
120QF	120	17	
60QF	60	17	
NQF			17
WQF		17	

Afterwards emulsions were stuffed into plastic, waterproof casings (diameter 42 mm) with a piston stuffer. Samples were then cooked at 85°[C] for 45 min in a thermostated water bath MK AQUATERM 192095, cooled in a water (T=40°C) and then in a refrigerator. The day aft[er] (stored in refrigerator T=5°C) emulsion coagulates were sensory evaluated with analytical descriptive test based on a 7 point scale for vario[us] attributes, as they are described in table 2. The colour of coagulates was also instrumentally analysed by Minolta CR 200 b chromometer in L (lightness), a (redness) and b (yellowness) system of colour. Determined L, a and b colour values were measured at 4 different locations of the longitudinal section of sausages.

RESULTS AND DISCUSSION

Sensory properties (Table 2)

Emulsion coagulates prepared with nitrite had significantly the best colour characteristic on T_0 and on T_1, irrespective of muscle's type. In sp[ite] of that, addition of CCMP resulted in more characteristic colour as compared to their uncured counterparts. However, coagulates 60LD [...] most closely resembled that of NLD. Shahidi and Pegg (1990) stated that the addition of CCMP to comminuted pork meat at 12, 18 and [...] ppm levels produced a pink colour which was visually indistinguishable from that of nitrite-treated samples.

All coagulates which were acceptable on T_0 (120LD, 60LD, NLD, NQF) were even better estimated on T_1 (after 2h in refrigerator). All groups, except NQF were on T_2 (after 2h on room temperature) scored below 4.00 which is a lower limit for colour acceptability. Colour uniformity was estimated for all groups relatively high, without significant differences. Only coagulates 60LD had slightly lower stability than all others. All coagulates prepared from QF had more optimal texture than corresponding LD. Samples with nitrite salt were the closest to optimal texture, irrespective of muscle used. While scores for the mouthfeel of group made from QF are relatively high and there is no significant differences, NLD coagulates were significantly the best evaluated for this textural property in the group LD. Neither addition for colour development nor muscle's type influenced juiciness, smell, strange smells and aftertastes. The latter two sensory properties were not perceived. The best flavour had coagulates with nitrite, irrespective of muscle used. Cured samples had the best overall acceptability. Coagulates 120LD and 60LD had significantly better overall acceptability than the same made from QF, while NQF were better than NLD.

Instrumental analyses of colour (Table 3 and 4)

As a rule all coagulates prepared from LD were significantly lighter (higher L values) than corresponding from QF. That is not surprising since QF samples had more native pigment which upon cooking became brown. Generally, an increase in addition level of CCMP cause a decrease in L values. They were lower as compared to nitrite cured and even to uncured corresponding samples. These results correspond to those of Shahidi and Pegg (1991).

All groups of coagulates made from QF, except 120QF had higher a values (more red) than corresponding from LD. As a rule, an increase in addition level of CCMP cause also an increase in a values. As showed previously sensory evaluated colour characteristic, again a values of coagulates 60LD the most closely resembled that of NLD. On the contrary, even 120QF had too low a values in comparison with NQF. So a larger amount of CCMP would be required for muscle with more native myoglobin, as suggested by Shahidi and Pegg (1991).

In general all groups made from QF were more yellow than corresponding made from LD. The lowest b values were measured on cured samples, irrespective of muscle used.

CONCLUSIONS

The pork muscle's type as well as the addition of pigment CCMP have a great influence on the colour of meat emulsion coagulates.

Both, sensory and instrumental analysis of coagulates' colour showed that coagulates made from LD with addition of CCMP, sinthesized from 60 mg of hemin closely resembled that of nitrite cured coagulates.

In coagulates made from QF it would be necessary to adjust the quantity of added CCMP to the native content of myoglobin.

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Table 2 Sensory properties of emulsion coagulates (mean values, analysis of variance, Duncan's test)

Property (scores)	120LD	60LD	NLD	WLD	F-value	120QF	60QF	NQF	WQF	F-value
colour characteristic T_0 (1-7)	4.50 ^{W}	5.33 $^{W, 120}$	6.22 ^{W,120,60}	1.00	423.56***	3.78 $^{W, 60}$	3.06 ^{W}	6.50 $^{W, 60, 120}$	1.00	653.14***
colour characteristic T_1 (1-7)	4.55 ^{W}	5.61 $^{W, 120}$	6.5 $^{W, 120, 60}$	1.00	641.93***	3.72 $^{W, 60}$	3.11 ^{W}	7.00 $^{W, 60, 120}$	1.00	188.32***
colour characteristic T_2 (1-7)	2.50 $^{W, N}$	3.17 $^{W, N, 120}$	1.61 ^{W}	1.00	77.70***	1.33	1.06	4.06 $^{W, 60, 120}$	1.00	157.82***
colour uniformity (1-7)	6.11	6.06	5.94	6.11	0.55	5.94	6.00	6.11	5.94	0.24
stability (1-7)	6.50 ^{60}	6.00	6.50 ^{60}	6.50 ^{60}	4.00*	6.50	6.50	6.50	6.50	----
fragility - gumminess (1-4-7)	2.33	2.72 ^{120}	3.44 $^{120, 60, W}$	2.83 ^{120}	12.77***	3.89	3.89	4.17 $^{120, 60}$	4.11 ^{60}	3.69*
mouthfeel (1-7)	3.50	3.83	4.33 $^{120,60, W}$	3.94 ^{120}	7.20***	5.33	5.55	5.55	5.39	0.78
juiciness (1-7)	5.50	5.50	5.44	5.50	1.00	5.50	5.50	5.50	5.50	---
smell (1-7)	5.50	5.50	5.50	5.50	---	5.33	5.33	5.39	5.28	0.30
strange smells (1-7)	1.00	1.00	1.00	1.00	---	1.00	1.00	1.00	1.00	---
flavour (1-7)	5.39	5.33	5.67 $^{W, 60, 120}$	5.17	6.59**	5.50 ^{W}	5.50 ^{W}	5.72 $^{W, 120, 60}$	5.22	10.87***
aftertastes (1-7)	1.00	1.00	1.00	1.00	---	1.00	1.00	1.00	1.00	---
overall acceptability (1-7)	5.00 ^{W}	5.33 $^{W, 120}$	6.00 $^{W, 120, 60}$	2.78	532.21***	3.94 $^{W, 60}$	3.44 ^{W}	6.39 $^{W, 60, 120}$	2.33	253.24***

colour characteristic T0, T1, T2 (1=uncharacteristic colour with faults, 7=characteristic colour), colour uniformity (1=unequal colour, 7=uniform colour), stability (1=unstable, 7=stable), fragility-gumminess (1=crumbly, 4=optimal texture, 7= gummy), mouthfeel (1=coarse, grainy 7=smooth), juiciness (1=extremely dry, 7=extremely juicy), smell (1=uncharacteristic smell, 7=characteristic smell), strange smells (1=none, 7=extremely strong), flavour (1=uncharacteristic, 7=charasteristic), aftertastes (1=none, 7=extremely strong), overall acceptability (1=unacceptable, 7=excellent)

T_0=fresh cross section slice; T_1=slice after 2 h in refrigerator (T = 5°C); T_2=slice after 2h on room temperature (T = 20°C)

* p≤0,05; ** p≤0,01; *** p≤0,001

Table 3 The influence of muscle's type on L, a and b values (mean values, analysis of variance, Duncan's test)

Group	Value	LD	QF	F value
120	L	69.35	65.97	57.45***
	a	9.34	8.35	20.67***
	b	10.00	11.02	26.05***
60	L	74.64	70.90	57.38***
	a	6.37	6.51	0.26
	b	9.41	10.95	126.55***
N	L	82.00	73.85	772.49***
	a	5.77	9.97	1140.82***
	b	7.65	8.13	13.43***
W	L-	83.46	76.04	545.18***
	a-	1.20	2.99	36.88***
	b-	9.72	11.36	30.60***

Table 4 The influence of addition for colour development on L, a and b values (mean values, analysis of variance, Duncan's test)

Group	Value	120	60	N	W	F value
LD	L	69.35	74.64 ^{120}	82.00 $^{120, 60}$	83.46 $^{120, 60, N}$	327.03***
	a	9.34 $^{B, N, 60}$	6.37 ^{B}	5.77 ^{B}	1.20	235.57***
	b	10.00 $^{N, 60}$	9.41 ^{N}	7.65	9.72 ^{N}	35.22***
QF	L	65.97	70.90 ^{120}	73.85 $^{120, 60}$	76.04 $^{120, 60, N}$	773.65***
	a	8.35 $^{B, 60}$	6.51 ^{B}	9.97 $^{B, 60, 120}$	2.99	1314.77***
	b	11.02 ^{N}	10.95 ^{N}	8.13	11.36 $^{N, 60, 120}$	242.74***