EFFECT OF WASHING PROCESS ON COLOR AND CHEMICAL COMPOSITION OF MECHANICALLY DEBONED POULTRY MEAT

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Background

Interest in processing of mechanically deboned poultry meat (MDPM) is currently growing. The underlying objective is to increase the overall value of low cost MDPM (Yang & Froning, 1994). Mechanically deboned poultry has a higher heme and fat content than hand-deboned poultry (Froning, 1976). The darker color from the higher heme content of MDPM is undesirable in poultry meat products directed towards the white meat market. The surimi processing involves repeated washing processes with an aqueous solution for removing heme pigments, fat and other undesirable substances (Dawson et al., 1988).

Objective

The purpose of this study was to investigate the effect of washing process (three washing times and three washing numbers) on chemical composition, pH and color of mechanically deboned poultry meat, to use in restructured poultry meat products.

Material and methods

Commercial MDPM was obtained from a local poultry slaughter plant and kept under freezing conditions (-22±2ºC). The MDPM was prepared and thawed at 4±1ºC. Washing solution was 0.1M sodium chloride (NaCl), ratio 1:3 (wt/wt), the MDPM was continuously mixed (110±10 rpm). The mixture was then undisturbed for 5 min, and the fat floating on the surface was skimmed off. Washed meat was collected by filtration and then pressed. The washing numbers studied were: 2, 3 or 4, and the washing times studied were: 10, 20 or 30 min.

Three replicates were run for each washing treatment. For MDPM and washed meat, fat and protein were determined using AOAC (1984). Moisture was determined by rapid method (Perez-Alvarez et al., 1995) and pH by a pH-meter with glass pH electrode. Color of the MDPM and washed meat was determinate by CIELAB (D65 as illuminant, 10° as standard observer). L* (lightness), a* (redness), b* (yellowness) were measured using a Minolta CR-300 (Minolta Camera, CO Osaka, Japan).

All data were analyzed using Statistica v 5.0 (Statsoft, 1995) analysis of variance. The significance of differences between means was determined using Tukey's test. Color parameters were analyzed using response surface methodology.

Results and discussion

Unwashed MDPM: the composition (table 1) was similar to previous reports in humidity (Froning, 1976; Dawson et al., 1988; Wimmer et al., 1993), fat (Dawson et al., 1988; Yang & Froning, 1992a; Yang & Froning, 1994) and protein content (Smyth & O'Neill, 1997; Nowsad et al., 2000).

Washed MDPM: pH of washed meat increased significantly ($p<0.05$) with washing times and numbers (table 2). Washing determined an increase in moisture content of the washing MDPM over 12% (mean ± S.E. value for all treatments was 78.3±0.8). No significant differences ($p>0.05$) in moisture content between treatments (washing times and numbers) were observed.

Fat content was significantly ($p<0.05$) reduced by washing numbers (table 2). The separation of fat during the aqueous washing was attributed to the differences in density and polarity of the washing solution and the lipid components in the meat (Yang & Froning, 1992b). As in previous reports (Dawson et al., 1989), protein content on a dry weight basis was increased ($p<0.05$) through the washing process (table 2) probably due to the leaching out of fat and sarcoplasmic proteins (Yang & Froning, 1992a; Yang & Froning, 1994).

Washing resulted in a significant ($p<0.05$) increase in lightness (figure 1), these results agreed with previous studies on MDPM (Navarro-Rodríguez de Vera et al., 2000). The water dilutes heme pigment concentration which is one of the main factors responsible of these color coordinate (Onyango et al., 1998).

In relation to the increased lightness, washing decreased redness (a* values) of the MDPM. The fundamental goal of the washing treatment is an effective extraction of heme pigments; the more heme pigments removed, the whiter the meat. As shown in figure 2, a* is more influenced by the increase of washing numbers than washing times. The minimal value observed in extreme conditions (4 washing steps of 30 min each; a*: 1.7±0.9) is lower than a* values observed in this laboratory for poultry meat breast (a*: 3.7±0.7). So, 4 washing steps of 10 min each (a*: 4.2±1.0) or 3 washing steps of 30 min each (a*: 3.9±0.6), could be enough to obtain a similar color to breast poultry meat.

Table 1. pH, proximate composition (moisture, fat, protein) and color (L*: lightness; a*: redness; b*: yellowness) of unwashed mechanically deboned poultry meat (MDPM) (mean values ± S.E.).

	pH	Moisture (%)	Fat[1] (%)	Protein[1] (%)	Color		
					L*	a*	b*
MDPM	6.4 ± 0.1	66.0 ± 2.1	44.3 ± 5.1	39.1 ± 4.9	53.2 ± 2.6	16.6 ± 2.1	14.3 ± 1.2

[1]calculated on dry weight basis

No significant differences ($p>0.05$) between treatments were observed in b* values, the mean value (± S.E.) obtained was: 12.1±2.7. Similar behavior was reported by Dawson et al. (1988; 1989).

Conclusions

On the parameters studied, modification of washing number was more effective than washing time.

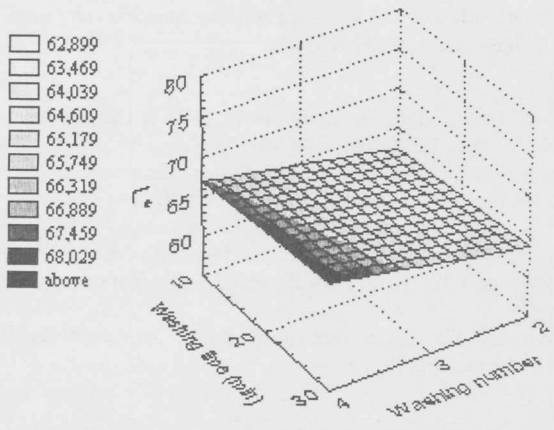
With regard to the color, lightness was higher and redness was lower with increased washing times and numbers.

The results suggest that, the more effective extraction of heme pigments was obtained with 4 washing steps of 30 min each. However, to obtain a similar color to the breast poultry meat 4 washing steps of 10 min each or 3 washing steps of 30 min each are enough.

Table 2. pH, fat and protein content of washed mechanically deboned poultry meat with the selected washing processes (washing times: 10, 20 or 30 min; washing numbers: 2, 3 or 4).

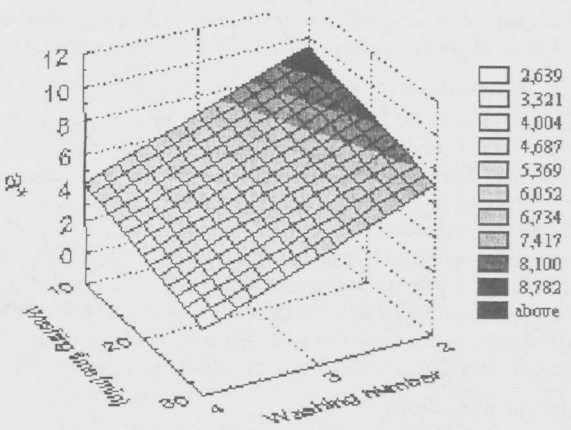
Washing numbers	pH			Fat (%)[1]			Protein (%)[1]		
	Washing times			Washing times			Washing times		
	10 min	20 min	30 min	10 min	20 min	30 min	10 min	20 min	30 min
2	6.58 a A[2]	6.51 a A	6.52 a A	39.0 a A[2]	39.6 a A	41.1 a A	43.2 a A[2]	43.8 a A	42.0 a A
3	6.79 a AB	6.64 a A	6.94 a B	38.3 a A	37.8 a AB	34.2 a B	42.6 a A	43.0 a AB	48.1 a A
4	6.86 a B	7.00 a B	7.36 b C	35.5 a A	34.0 a B	37.6 a AB	47.6 a A	48.6 a B	44.3 a A

[1]calculated on dry weight basis
[2] Means within rows with different small letter are significantly different ($p<0.05$); means within columns with different capital letter are significantly different ($p<0.05$).



$L^* = 57.11 + 2.29\ N + 0.07\ t$ R^2:0.39 $p<0.0001$

Figure 1. Lightness (L* value) evolution on washing mechanically deboned poultry meat with the selected washing processes. Washing times (t): 10, 20 or 30 min; washing numbers (N): 2, 3 or 4 steps.



$a^* = 15.88 - 2.61\ N - 0.12\ t$ R^2:0.71 $p<0.0001$

Figure 2. redness (a* value) evolution on washing mechanically deboned poultry meat with the selected washing processes. Washing times (t): 10, 20 or 30 min; washing numbers (N): 2, 3 or 4 steps.

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