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The use of marination to improve poultry meat quality

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ABSTRACT - A study was conducted to determine the effect of marination on turkey breast meat quality traits. Breast meat samples were marinated with two types of solution (containing sodium tripolyphosphate, STPP or a commercial mix with sodium carbonate and citrate, COM) and three solution/meat ratios (14, 18, and 22%). Marination with STPP determined a higher increase of meat pH in comparison with COM (ΔpH measured before and after marination: +0.20 *vs.* +0.14; P≤0.05). The marinade uptake and AK-shear values did not differ between solutions, whereas STPP determined a higher marinade retention (98.2 *vs.* 97.9%; P≤0.05) and a strong decrease of cooking loss (21.8 *vs.* 28.1%; P≤0.01) compared with COM. The increase of solution/meat ratio from 14 to 22% significantly raised meat pH, marinade uptake, and cooking loss of the meat. Taking into account both marinade uptake and cooking losses, the use of a 14% solution/meat ratio allowed to maximise processing yield. Overall, compared to non-marinated meat, marinated meat exhibited a higher lightness and yellowness, and a lower AK-shear value after cooking, confirming that this technique can be successfully employed to improve meat texture.

Key words: Poultry meat, Marination, Quality traits.

Introduction – Marination is a commonly used method of adding value to different types of meats which involves injection and/or tumbling to disperse in a muscle a solution of water, salt and other ingredients. Historically, the purpose of marinating was to preserve the meat. While meat preservation is still an important issue, today, marinating is commonly used to enhance yield by increasing water content and retention, to change the flavour profile of products and to improve meat tenderness and juiciness (Sen *et al.*, 2005; Alvarado and McKee, 2007). Injection of various salts into meat cuts is commonly practised to enhance the tenderness and juiciness of fresh meat products. In general, the addition of sodium chloride at the meat causes transverse expansion of the myofibrils due to the electrostatic repulsion and partially solubilization of proteins, which together promote uptake of water (Offer and Trinick, 1983). Moreover, addition of phosphates such as sodium tripolyphosphate increases water holding capacity due to protein extraction and shifting of the pH from the isoelectric point of the muscle's proteins (Barbut, 2002). Other ingredients have been purposed to replace phosphates in meat products due to their negative nutritional drawbacks. Sodium carbonate and bicarbonate are known to be superior marinating agents, which reduce drip loss and shear force and improve the yield of enhanced meat (Bertram *et al.*, 2008). This study was conducted in order to determine the quality traits of turkey breast meat marinated using two types of marinating solution and three solution/meat ratios (14, 18 and 22%) and to compare characteristics of marinated and non-marinated meat.

Material and methods – For this study, seventy turkey breast (*P. major* muscle) meat slices were obtained at 48h *post mortem* and subsequently trimmed to yield a 7×12×0.5cm experimental samples. Sixty samples were subjected to vacuum tumbling by using two marinating solutions (containing sodium tripolyphosphate, STPP, or a commercial mix with sodium carbonate and citrate, COM) and three solution/meat ratios (14, 18, and 22% wt/wt) (n=10 *per* treatment). The STPP solution was prepared with water (96.6%), sodium chloride

(1.4%), and STPP (2.0%), whereas the COM solution was prepared with water (98.08%), sodium chloride (1.05%), and a mix of additives (hydrolyzed yeast extract, sodium chloride, dextrose, sodium citrate, and sodium carbonate) (0.87%). The amount of sodium chloride added to the COM solution was calculated in order to achieve the same total concentration of sodium chloride adopted in STPP solution. Meat pH (Jeacocke, 1977) and colour (lightness, L*; redness, a*; yellowness, b*; by Minolta CR-400) were measured before and after marination and their variations were calculated (i.e. $\Delta L^* = L^*_{\text{after marination}} - L^*_{\text{before marination}}$). After marination, the following measurements were carried out: marinade uptake (% of weight gain after marination), marinade retention (% of weight retained by the marinated meat kept suspended on a plastic net for 24h at 2-4°C), cooking loss (%; after cooking the samples on a convention oven at 180°C until 80°C at core sample), and AK-shear values after cooking (kg/g; Papinaho & Fletcher, 1996). Finally, 10 meat samples were kept as "non-marinated" and used to determine pH, colour, cooking loss and AK-shear values after cooking. Data were analysed by two-way ANOVA (2×3 factorial design) to test the effect of type of marinating solution (STPP, COM) and solution/meat ratio (14, 18, and 22%) on meat quality traits. Means were separated by Duncan's test. Finally, one-way ANOVA was performed in order to compare marinated and non-marinated meat quality traits.

Results and conclusions – The influence of marinating solution and solution/meat ratio on quality traits of turkey breast meat is reported in Table 1. As for meat pH, both the STPP and COM determined a shifting of the meat pH towards higher values due to the alkaline properties of sodium tripolyphosphate and sodium carbonate/sodium citrate, respectively. However STPP produced a higher increase of pH in respect with COM (ΔpH=+0.20 *vs.* +0.14; P≤0.05). Regarding solution/meat ratio, the 22% treatment determined a higher increase of meat pH in respect with 14 and 18% (ΔpH=+0.22 *vs.* +0.13 and +0.16, respectively; P≤0.01). Concerning the meat colour, in respect with COM, STPP exhibited a higher decrease of redness (Δa*=-0.77 *vs.* -0.40; P≤0.05) and a lower increase of yellowness (Δb*=+0.16 *vs.* +1.29, P≤0.01). It was found that ΔL* and Δb* were higher in 14 and 18% than 22%. The marinade uptake was not influenced by the type of solution, whereas STPP produced a higher marinade retention (98.2 *vs.* 97.9%; P≤0.05) and

Table 1. Influence of marinating conditions on turkey breast meat quality traits.

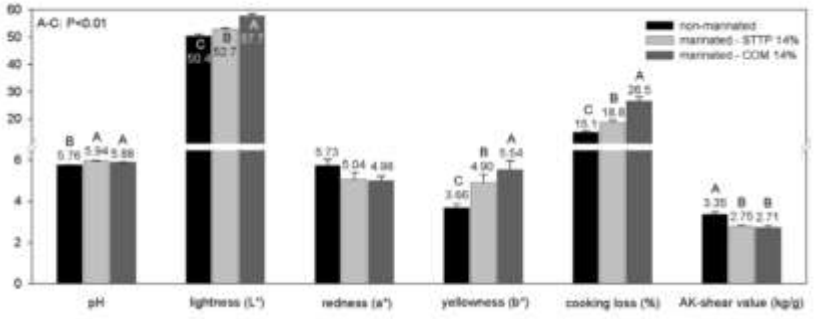
	Type of Solution (TS)		Solution/Meat ratio (SM)				Probability[2]	
	STPP	COM	14%	18%	22%	sem[1]	TS	SM
n.	30	30	20	20	20			
pH before marination	5.80	5.74	5.78	5.77	5.76	0.01	*	ns
pH after marination	6.00	5.88	5.91b	5.93b	5.98a	0.01	**	**
Δ pH	0.20	0.14	0.13b	0.16b	0.22a	0.01	*	**
L* before marination	52.5b	54.9	53.1	53.6	54.3	0.3	**	ns
a* before marination	6.05	5.59	5.53	6.02	5.91	0.11	*	ns
b* before marination	4.63	4.38	4.21	4.55	4.76	0.15	ns	ns
L* after marination	54.2	57.2	55.2	56.2	55.4	0.4	**	ns
a* after marination	5.27	5.19	5.01	5.45	5.24	0.12	ns	ns
b* after marination	4.80	5.67	5.22	5.60	4.88	0.15	**	ns
ΔL*	1.72	2.33	2.06a	2.99a	1.04b	0.22	ns	**
Δa*	-0.77	-0.40	-0.52	-0.56	-0.67	0.08	*	ns
Δb*	0.16	1.29	1.01a	1.05a	0.12b	0.15	**	**
Marinade uptake (%)	10.1	10.3	7.7c	10.3b	12.6a	0.5	ns	**
Marinade retention (%)	98.2	97.9	98.1	98.2	97.9	0.1	*	ns
Cooking loss (%)	21.8	28.1	22.6b	25.8a	26.4a	0.7	**	*
AK-shear value (kg/g)	2.78	2.84	2.73	2.94	2.75	0.04	ns	ns

*[1]Standard error of the mean. [2]No interaction TS×SM. *=P≤0.05; **=P≤0.01; ns: not significant; a-c=P≤0.05.*

a lower cooking loss (21.8 *vs.* 28.1%; P≤0.01) in respect with COM. These results confirm that STPP is one of the most active ingredient for raising the water binding capacity of the meat due to many direct and indirect effects exerted on meat proteins and structure (Xiong and Kupski, 1999; Barbut, 2002).

The AK-shear values were not affected by the type of solution despite wide differences in cooking loss between treatments. As for the solution/meat ratio, the marinade uptake increased from 14 to 18 and 22% (7.7 *vs.* 10.3 *vs.* 12.6%, respectively; P≤0.01) without impairing the marinade retention. The same trend observed for marinade uptake was found for cooking loss which was lower in 14% than in 18 and 22% treatments (22.6 *vs.* 25.8 and 26.4%, respectively; P≤0.05). The solution/meat ratio did not affect AK-shear values of cooked meat. Taking into account both marinade uptake and cooking losses, the use of a 14% solution/meat ratio allowed to maximise processing yield. Comparing the quality traits of non-marinated and marinated meat with 14% solution/meat (Figure 1), it was found that marination produced a paler (>L*) and more yellow (>b*) colour of the meat (P<0.01), increased cooking loss (P<0.01), and reduced AK-shear values (P<0.01), confirming that this technique can be successfully employed to improve meat tenderness.

Figure 1. Quality traits (mean ±sem) of non-marinated and marinated (14% solution/meat) meat.



In conclusion, this study confirmed that major changes occur during poultry meat marination, involving product appearance, texture, and processing yield. Moreover, it was established that both the ingredients and solution/meat ratio play a key role in determining the process yield with special emphasis to the uptake of marinating solution and subsequent losses during cooking. Thus, the best marinating conditions to adopt are strongly related to type of product (i.e. sold as ready-to-cook or ready-to-eat) and/or further processing steps to which the meat is subjected (cooking method, packaging system, etc.).

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