PHYSICOCHEMICAL PROPERTIES OF MEAT BATTERS WITH ADDED WALNUT: EFFECT OF SALT LEVELS

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Background

Epidemiological studies show that frequent consumption of nuts in general, and walnuts in particular, correlates inversely with myocardial infarction or death by vascular ischaemic disease (Sabaté, 1993). This effect has been associated with the peculiar blend of nutrients and phytochemical compounds found in walnuts, which exert beneficial effects on serum lipid profiles and other risk factors that can cause or exacerbate cardiovascular diseases .

One of the various strategies that have been adopted to achieve healthier meat products is the reformulation of meat derivatives to incorporate ingredients like walnut that can confer potential heart-healthy benefits. Meat products have been formulated with added walnuts, resulting in products with acceptable physicochemical and sensory properties (Jiménez Colmenero *et al*., 2003; Carballo, *et al*., 2003; Cofrades *et al*., 2004).

Since high salt intake has been related to high blood pressure and a considerable proportion of dietary salt comes from meat and meat products, there is growing interest among consumers and processors in reducing the use of salt (minimizing sodium) in meat processing. However, reducing salt limits the extractability of proteins and alters the pattern of denaturation and thermal aggregation of the major muscle protein (Trout & Schmidt, 1986), thus influencing the characteristics of meat products. No data are available on how salt level affects meat batter physicochemical properties formulated with added walnut.

Objectives

The purpose of this study was to determine how the percentage of NaCl (1.5 and 2.5 %) influences the effect of added walnut (0 and 20 %) on physicochemical properties (texture, binding properties) of raw and cooked meat batters.

Materials and methods

Pork meat and walnut (particle size approx. 12 μm) were used to prepare four different meat batters. Two control lots (C) were prepared with 85% meat, 0.18 % sodium tripolyphosphate, water, and salt in two concentrations: 1.5 % (LS) and 2.5 % (NS). Two samples with added walnut (W) were also prepared, in which 20 % of the meat was replaced by an equal percentage of walnut. The ingredients were homogenized and ground in a chilled cutter (2 °C) (Stephan Universal Machine UM5, Stephan u. Sóhne GmbH & Co., Hameln, Germany). Mixing time was standardized to 5 min and the final temperature was below 10 °C in all cases. The batters (60 ± 0.5 g) were placed in jars (diam = 33 mm), and some were heated to an internal temperature of 70 °C. After tempering for 1 hr, weight loss (WL) was determined and expressed as % initial sample weight. Determinations were carried out in quadruplicate.

Protein, fat, moisture, ash and pH of the raw samples (non-heated) were determined as in Jiménez Colmenero *et al*., (2003). Penetration tests were carried out (6 determinations) on raw samples in their containers once they attained ambient temperature (20-22 °C). The tests were performed with a 5 mm diameter cylindrical stainless steel plunger attached to a 50 N cell connected to the crosshead of a TA-XT2 Texture Analyser (Texture Technologies Corp., Scarsdale, NY). Force-deformation curves were obtained at 0.8 mm/s crosshead speed. Gel strength (GS) (J) was estimated as the force-deformation area after penetration to 3 mm. Texture Profile Analysis (TPA) was performed as described by Bourne (1978). Six cores (diam = 30 mm, height = 20 mm) from cooked samples were axially compressed to 30 % of their original height. Force-time deformation curves were derived with a 250 N load cell applied at a crosshead speed of 0.8 mm/s.

Two-way analysis of variance by F test and least squares differences by Statgraphics 2.1 (STSC Inc., Rockville, MD) were used to compare mean values and to identify significant differences ($P<0.05$) among treatments (added walnut and salt levels).

Results and discussion

Addition of walnut increased ($P<0.05$) fat (C 2.6 %, W 14.5 %) and decreased ($P<0.05$) moisture (C 75.7 %, W 62.5) contents in meat batters. Ash proportions were lower ($P<0.05$) in LS (2.4 %) than in NS (3.6 %). The pH values of meat batters increased ($P<0.05$) with added walnut (C 5.6, W 6.0) .

Higher levels of salt translated into higher ($P<0.05$) GS values in raw meat batters (Figure 1). The difference was only significant with 1.5 % NaCl, indicating that the effect of walnut addition on GS was influenced by the salt concentration. In meat batters containing 2.5 % NaCl, weight losses were lower than 4 %, indicating good water and fat binding properties. Values were similar in LS sample containing 20 % of added walnut (Figure 2).

Some textural parameters (e.g., Hd and Cw) of heated samples varied according to the salt concentration, but not significantly (Table 1). There has been conflicting reports on the effect of salt on texture, and it has been suggested that these have to do with the diversity of factors that can influence thermal gelation processes (Jiménez-Colmenero et al., 1998). When walnut was added, gel/emulsion structures exhibited lower ($P<0.05$) values of Hd, Sp, Ch and Cw (Table 1). The changes induced by walnut were possibly due to a number factors Walnut addition caused an increase in the fat level (and a decrease in the percentage of moisture) of the meat batters. Contrary to the results of this experiment (Table 1), it has been reported that a higher protein/moisture ratio produces harder structures (Carballo et al., 1996). On the other hand, while protein contents were comparable (19.4 %), the addition of walnut entailed a decrease in the amount of meat protein in favour of globular (walnut) proteins, which generally tends to interfere with muscle protein interactions (Lee, Wu and Okama, 1992). This limited the formation of a thermal gel matrix system, resulting in softer structures (Table 1) with good water and fat binding properties (Figure 2).

Conclusions

Walnut affected the properties of meat batters. Their presence limited the gel forming ability of protein matrixes so that meat batters were softer and less cohesive, but they did maintain good water and fat binding properties. Salt levels did not influence the effect of walnut on texture (TPA parameters) and weight loss. These results suggest that addition of walnut may be a way not only of promoting the various bioactive compounds existing in walnut but also of reducing sodium content in meat products of this kind. Such characteristics are highly appreciated by the growing number of consumers currently interested in functional foods.

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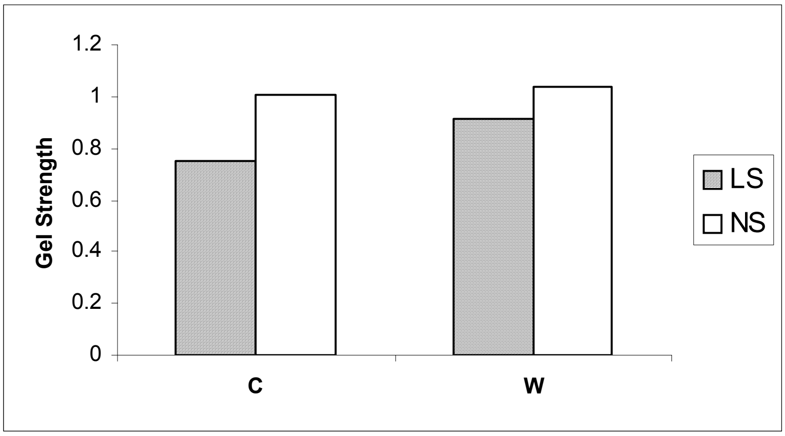
Acknowledgments. This research was supported under project AGL2001-2398-C03-01. Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica (I+D+I). Ministerio de Ciencia y Tecnología. Thanks are due to "La Morella Nuts, S. A." for supplying the walnuts.



Figures 1. Gel strength (J x 10^{-3}) of raw meat batters control (C) and with 20 % of added walnut (W) as a function of salt levels 1.5 % (LS) and 2.5 % (NS). Different letters for added walnut and different number for salt levels indicate significant differences (P<0.05).

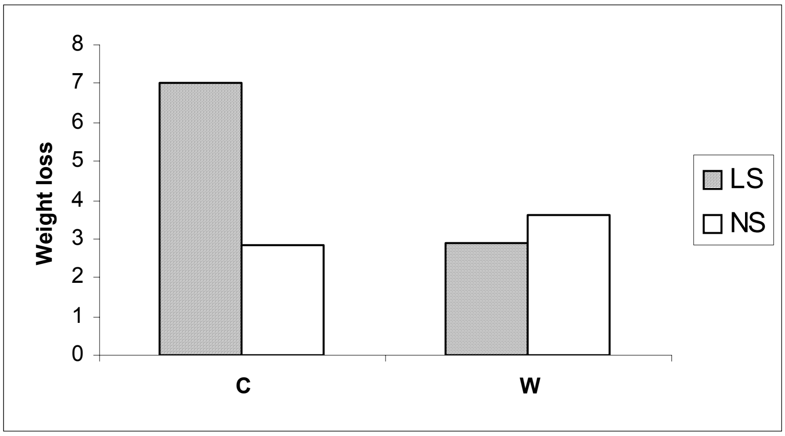


Figure 2. Weight loss (%) of meat batters control (C) and with 20 % of added walnut (W) as a function of salt levels 1.5 % (LS) and 2.5 % (NS). Different letters for added walnut and different number for salt levels indicate significant differences (P<0.05).

Table 1. Texture profile analysis of cooked meat batter control (C) and with 20 % of added walnut (W) as a function of salt levels 1.5 % (LS) and 2.5 % (NS).

	Hardness (N) Hd		Springiness (mm) Sp		Cohesiviness		Chewiness (Nxmm) Cw	
Samples	LS	NS	LS	NS	LS	NS	LS	NS
C	60.37^{a}_{1}	62.87^{a}_{1}	5.37^{a}_{1}	5.33^{a}_{1}	0.515^{a}_{1}	0.514^{a}_{1}	166.85^{a}_{1}	172.65^{a}_{1}
W	48.18^{b}_{1}	50.29^{b}_{1}	5.13^{a}_{1}	5.08^{b}_{1}	0.487^{b}_{1}	0.484^{b}_{1}	120.67^{b}_{1}	123.88^{b}_{1}
SEM	1.22		0.06		0.003		3.98	

Different letters in the same column and different numbers in the same row indicate significant differences ($P<0.05$). SEM = Standard error of the mean.