SOYA BUDS AS ANTIOXIDANT AGENTS IN COOKED MEAT EMULSION.

Doval, M.M; Romero, A.M.; Sturla, M.A.; Andreo, A.I. and Judis, M.A.
Facultad de Agroindustrias, UNNE, C. Fernández 755, CP 3700, Sáenz Peña, Chaco, Argentina. (e-mail: judis@fai.unne.edu.ar)

Background

Interest in employing antioxidants from natural sources to increase the shelf-life of foods is considerably enhanced by consumer preferences for natural ingredients and concerns about the toxic effects of synthetics antioxidants (Schwarz et al., 2001).
The cooked meat emulsion products are complex systems whose components are distributed in true solutions, in colloidal solutions, in suspension and in form of foam (Prändl, 1994).The heat applied in the course of food processing produces many chemical reactions which involves the production of flavours, but also generated off-flavour that could affect nutritional value and food safety (Lomano and Nawar,1982; Shantha and Decker, 1994; Aubourg, 1998).
Some •OH generation mechanism of prooxidant systems must be destroyed in cooked meat, but superoxide anion ($•O_2^-$) could still be generated by the electron transfer reaction of Fe^{2+} with the molecular oxygen if oxygen is available (Fenton reaction), and the propagation process of lipid oxidation could be continued (Ahn et al., 1993).
In a previous work, we reported that soya bud has antoxidant activity on fused lard due to high superoxide dismutase (SOD) enzyme concentration present in it (Doval et al., 2001). Therefore, the enzyme obtained from this source is unusually stable to heat, so that it could be added into food ingredients which will be exposed to a thermal processing.

Objective

In an attempt to reduce oxidative deterioration, including the development of warmed off flavour of meat products, we it evaluated the antioxidant effect of soya buds added to cooked meat emulsion stored in high oxygen permeability packaging.

Materials and Methods

Preparation of soya buds
The soya buds were obtained from previously selected soya beans, which were soaking in water and then germinated in darkness at 30 ºC in a controlled temperature chamber. Once the buds reached 1cm of length, they were separated from the beans and were dehydrated at 30 ºC during 24 hours in a static drying chamber (13,7 % humidity). Concentrations of 0 % w/w (A) ; 0.5 % w/w (B) and 1% w/w (C) of triturated dry buds were emulsified on meat emulsion before cooking.
Meat emulsion.
48% of beef, 35 % pork, 15 % lard and 2% NaCl were ground and emulsified in a colloidal mill (Cryma ®). The meat emulsion was moldered in patties of 70 ± 1 g each one. They were heated in static oven at 80 ºC during 2 h. Then they were packed (RAPI-VAC S-750 ®) in polyethylene bags with an oxygen transmission rate of 2000 $cm^3\ m^{-2}\ day^{-1}$. All samples were stored at 15 ºC during 15 days. The development of lipid oxidation on the products was determined after chill storage for 0, 7 and 15 days.
Lipid oxidation measurement
Thiobarbituric acid reactive substances (TBARS) were measured by the spectrophotometric method at 531 nm (Beckman DU® 640B spectrophotometer). They were measured by duplicate on each sample and expressed as µmoles of malonaldehyde per kilogram of dry matter using tetramethoxypropane as the standard.
Lipids were extracted by Bligh and Dyer (1959) method. Peroxide value (PV) was performed on extracted lipids. PV was measured by the IDF-FIL 74A: 1991 official method (expressed as milliequivalents of oxygen per kilogram of sample).
SOD Assay
2 g of dehydrated buds were ground in a grinder, and were extracted in a 40 ml 50 mM tris-HCl buffer, pH 8.0, containing 1 mM EDTA, through all night at 4 ºC. The resulting slurry was centrifuged at 5000 rpm for 20 min. The SOD assay is routinely used for the measurement of superoxide dismutase in barley. This method relies on the inhibition by superoxide dismutase of the reduction of cytochrome *c* by superoxide anions produced in the oxidation of xanthine. (Bamforth, 1983). SOD from *Bacillus stearothermophilus* was used to compare (Sigma Chem Co.)
Protein content in crude extract was measured by the method of Biuret (Doumas et al.;1971)
Statistical design and analysis
Data obtained during storage were analyzed using a response surface methodology in Statgraphics Plus for Windows ® 4.0 software package. Experimental design adopted was multilevel factorial 3^2, in which the two factors or independent selected variables were: Soya Buds Concentration (C) and Storage Time (T), while the variable response were: Peroxide value (PV) and Thiobarbituric-acid-reactive substances (TBARS).

Results and Discussion

In this experience, like fused lard model system, an antioxidant effect was found at higher concentration of soya buds added to cooked meat emulsion. Average values for PV and TBARS are presented in Table 1.
Total activity SOD and specific SOD activity in crude extracts from dehydrated soya buds was 1135 units/g dry matter and 7.19 units /mg protein, respectively.
For TBARS development, 0.5 % w/w and 1% w/w soya buds concentration shown to be significantly relevant until 15th day of storage. However for PV formation 0.5 % w/w concentration had antioxidant effect until 7th day and only the higher concentration added was effective until 15th day. This behavior could be associated with a possible interaction between SOD enzyme of soya buds and any compound of meat emulsion, when the enzyme concentration is low.
The analysis of variance for PV and TBARS (Table 2) showed that the selected statistical model is satisfactory. Furthermore, high significance statistical was found for both studied effects (concentration of soya buds and time). The relationship between factors and PV and TBARS responses can be better understood by examining the response surface plots in Figures 1 and 2, respectively.

Conclusion

According to the obtained results the soya buds added to cooked meat emulsion contribute to inhibit PV and TBARS formation, being 1% w/w the most effective concentration. Data suggest the opportunity the adding soya buds to prevent oxidative mechanism and to increase the shelf life of storage cooked meat emulsion.

Pertinent Literature

Ahn, D.U.; Ajuyah, A.; Wolfe, F.H. and Sim, J.S. (1993). Oxygen Availability Affects Prooxidant Catalyzed Lipid Oxidation of Cooked Turkey Patties. *Journal of Food Science*. 58 (2): 278-282 + 291.

Bamforth, C.W. (1983). Superoxide dismutase in barley. *Journal of the Institute of Brewing*, 89, 420-423.

Doumas, B.T; Watson, W.A and Biggs, H.G. 1971. Acta de Química Clínica. 31: 1-87

Doval,M.; Romero, A.; Sturla, M. and Judis , M. (2001).Antioxidative Effect of Soya Bud in Model Systems. *European Food Research and Technology*. 213 (4/5): 297-300.

Lomanno, S.S. and Nawar, W.W. (1982). Effect of Heating Temperature and Time on the Volatile Oxidative Decomposition of Linolenate. *Journal of Food Science*. 47, 744–752.

Prändl, O.; Fischer, A.; Schimidhofer, T. And Sinell, H. J. (1994).*Fundamentos de la conservación de la carne en Tecnología e Higiene de la Carne*. Editorial Acribia.

Schwarz, K.; Bertelsen, G.; Nissen, L.; Gardner, P.; Heinonen, M.; Hopia, A.; Huynh-Ba, T.; Lambelet, P.; McPhail, D.; Skibsted, L. and Tijburg, L. (2001). Investigation of plant extract for the protection of processed foods against lipid oxidation. Comparison of antioxidant assays based on radical scavenging, lipid oxidation and analysis of the principal antioxidant compounds. *European Food Research and Technology*. 212:319-328.

Shantha, N.C. and Decker, E.A. (1994). Rapid, Sensitive, Iron-Based Spectrophotometrics Methods for Determination of Peroxide Values of Food Lipids. *Journal AOCS International*. 77(2),421-424.

Table 1. Result of the chemical analyses

Day	PV (meq O_2/L)			TBARS (µmol MAD/Kg)		
	A	B	C	A	B	C
0	2.03±0.04	2.47±0.08	2.29±0.17	3.48±0.11	4.37±0.20	3.44±0.00
7	67.72±1.34	61.07±1.28	47.62±1.69	7.85±0.30	7.26±0.37	7.27±0.51
15	47.31±0.40	54.13±2.32	30.76±1.79	13.51±1.72	10.75±0.50	8.36±0.04

Table 2. Statistical parameters of ANOVA for PV and TBARS

Response	p - value		R^2 (adjusted for d.f.)	Lack – of -fit
	Concentration	Time		
SQRT(LOG(PV)) (meq O_2/Kg)	0.009	0.000	99.67	0.077
TBARS (µmol MAD/Kg)	0.009	0.000	88.85	0.398

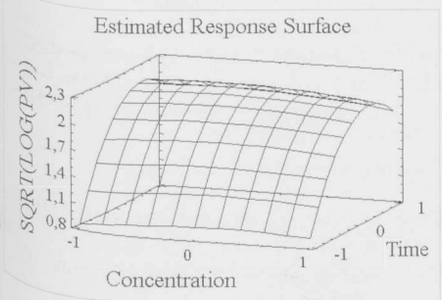

Figure 1. Response surface plots for PV

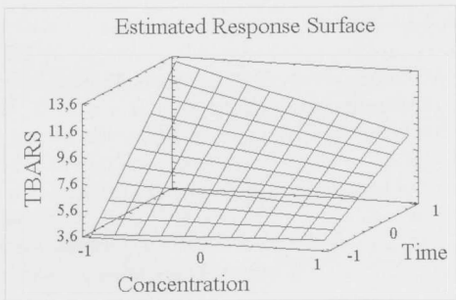

Figure 2. Response surface plots for TBARS