PS8.05 Residues of wine industry as antioxidant in processed, cooked, vacuum packaged poultry meat stored under frozen storage 9.00

Carmen J Contreras-Castillo (1) ccastill@esalq.usp.br, M M. Selani(1), T Z. Silva 1, V G. Packer 1 M Plata-Oviedo 2
(1)Esalq - Universidade de São Paulo/USP, Brazil
(2)Universidade Tecnológica Federal do Paraná, Brazil

***Abstract*—the effect of grape seed and peel extract of Isabel(IE) and Niagara (NE) varieties and the synthetic antioxidants butylhydroxytoluene (BHT) and sodium erythorbate in the oxidative stability and sensory acceptance of processed, cooked, vacuum packaged and frozen stored poultry meat was determinated. The poultry meat was ground, homogenized in cutter, on which was added the antioxidant. The sodium chloride was added to all treatments. The samples were molded, cooked in hot plate type grill (72°C), vacuum packaged and stored under cold storage (-18°C) for 9 months. The lipid oxidation was monitored by the determination of thiobarbituric acid reactive substances (TBARS) and acceptance of samples by sensory evaluation, which was made after processing (time 0) and after 3, 6 and 9 months of storage. Based on the TBARS values, IE and NE promoted satisfactory effect in protecting against lipid oxidation. In sensory evaluation, there was a little alteration in the odour and flavour attributes, however the extract addition promoted alteration in the colour of the samples ($p<0.05$).**

C. J. Contreras-Castillo is with Escola Superior de Agricultura "Luiz de Queiroz"/ESALQ, Universidade de São Paulo/USP, Brasil (e-mail: ccastill@esalq.usp.br)

M. M. Selani is with the Escola Superior de Agricultura "Luiz de Queiroz"/ESALQ, Universidade de São Paulo/USP, Brasil (e-mail: selani@esalq.usp.br).

T. Z. Silva, is with Escola Superior de Agricultura "Luiz de Queiroz"/ESALQ, Universidade de São Paulo/USP, Brasil (e-mail: tamarazago@yahoo.com.br).

V. G. Packer, is with Escola Superior de Agricultura "Luiz de Queiroz"/ESALQ, Universidade de São Paulo/USP, Brasil (e-mail: vivi_packer@hotmail.com).

M. P. Oviedo, is with Universidade Federal Tecnológica do Paraná, Brasil (e-mail: mapaove@utfpr.edu.br).

***Index Terms*— grape seed and peel extract, lipid oxidation, processed poultry meat, TBARS.**

I. INTRODUCTION

DUE the popularity of poultry meat consumption, which is the second most consumed meat in the world, its transformation into processed products is extremely important to supply the demand for variety and convenient foods. Unsaturated lipids, fine grinding, incorporation of air, heme pigments, metals and elevation of temperature during processing contribute to the lipid oxidation [1].

In foods, the lipids affect the meat properties of texture, juiciness, flavour and colour. In an attempt to control the lipid oxidation process and their undesirable changes, the industry has made use of antioxidants. However, in the case of synthetic antioxidants, researches found that these compounds have a toxic potential, leading to restriction of its use in several countries and the consumers' growing opposition [2, 3]. Therefore, researches have been studying the possibility to use additives or natural alternatives to extend the shelf-life, increase security and avoid the damage of lipid oxidation [4].

The use of natural antioxidants to reduce the oxidation is not a new concept and studies in this area come from mid-1980 and include plant and seed extracts and fruit juice concentrates [5]. Among these, we can mention the grape residue, which has now been extensively studied as a natural antioxidant in food. The antioxidant activity of this substance is attributed to the presence of phenolic compounds [6]. Furthermore, the use of grape seed and peel extracts has shown to be viable because the raw materials are the byproducts of the wine process, which represent an increasingly greater interest in environmental and economic aspects.

Thus, the objective of this study was to evaluate the oxidative stability and sensory acceptance of cooked poultry meat, subject to the addition of grape seed and peel extracts of Isabel and Niagara varieties, during frozen storage (-18ºC) in the vacuum packaging, for nine months.

II. MATERIALS AND METHODS

To obtain the extracts, samples of 20g of dried and ground grape seed and peels were extracted with ethanol 80% and kept under shaking for 48 hours. The supernatants were recovered by filtration and concentrated in evaporator. The residues were dissolved in water until volume of 50 mL.

For preparation of the poultry samples, 8 kg of thigh and 8 kg of drumstick boneless and skinless poultry were used, crushed separately in a grinder with disc number 8. The ground beef was divided into 5 parts, to which antioxidant and salt were added. The addition of grape seed extracts was determined according to their content in total phenolic compounds (TPC). The description of the treatments proceeds in the table 1.

Table 1. Identification of treatments.

Treatment	Ingredients
Control (CNTL)	1.5% NaCl, without antioxidant
Butylhydroxytoluene (BHT)	1.5% NaCl, 0.01% BHT dissolved in 5ml of soy oil
Isabel Grape Extract (IE)	1.5% NaCl, volume of IE equivalent to 60mg TPC/kg of meat = 5% of extract
Niágara Grape Extract (NE)	1.5% NaCl, volume of NE equivalent to 60mg TPC/kg of meat = 4% of extract
Sodium erythorbate+ Citric acid+Sugar (ERS)	1.5% NaCl, 0.37% of Sodium erythorbate + Citric acid + Sugar

After adding the ingredients, the mixture was homogenized in cutter. Samples were molded and cooked in a hot plate, until the internal temperature reached 72°C. The samples were vacuum packaged and stored under frozen storage (-18°C) for 9 months.

The extent of lipid oxidation (TBARS values, thiobarbituric acid reactive substances) expressed as mg of malonaldehyde (MDA)/kg sample was determined by the method of Sorensen & Jorgensen [7] and Vyncke [8].

The sensory evaluation was conducted by a trained panel of 12 members, evaluating attributes of colour, taste and odour alteration. Each member recorded his trial on a 10 cm unstructured scale, where the intervals represents numbers from 0 (absent) to 10 (intense).

Both tests were carried out after processing (time 0) and after 3, 6 and 9 months (time 3, 6 and 9) of frozen storage. All data were analyzed in duplicate, using the software SAS (Statistic Analisy System) by analysis of variance (ANOVA), applying the Tukey test with 95% confidence ($p<0.05$).

III. RESULTS AND DISCUSSION

A. Determination of lipid oxidation (TBARS)

Treatments with addition of natural antioxidant, during all the storage period, decreased significantly ($p<0.05$) the values of TBARS compared to CNTL (figure 1), reaching the end of 9 months of storage in a reduction of approximately 59% in both treatments (table 2). However, although the natural antioxidants have shown significant effects in reducing the levels of oxidation at the end of 9 months of freezing, the BHT treatment was the one which gave the samples greater stability on the lipid oxidation, with a value of 1.92mg of MDA/kg sample, followed by treatments IE, NE, ERS and CNTL, with values of 4.00, 4.01, 4.73, 9.65 mg MDA/kg sample, respectively.

Figure 1: TBARS values of the treatments with cooked and vacuum packaged poultry, during frozen storage (9 months).

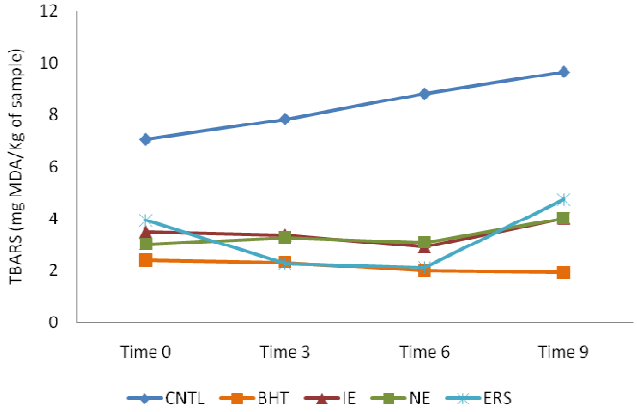

Table 2 – Mean of TBARS values of cooked and vacuum packaged poultry samples in different treatments, after processing and stored at 3, 6 and 9 months of freezing (-18°C).

Treatment	TBARS (mg MDA/kg of sample)			
	Time 0	Time 3	Time 6	Time 9
CNTL	7.07^{aC}	7.85^{aBC}	8.81^{aAB}	9.65^{aA}
BHT	2.41^{dA}	2.32^{bA}	1.98^{cA}	1.92^{dA}
IE	3.49^{bcA}	3.36^{bA}	2.91^{bA}	4.00^{cA}
NE	3.02^{cB}	3.28^{bB}	3.08^{bB}	4.01^{cA}
ERS	3.93^{bB}	2.28^{bC}	2.12^{cC}	4.73^{bA}

According to the study of Brannan and Mah [9] that evaluated the antioxidant effect of grape seed extract (0.1 and 1%) in cooked, vacuum packaged poultry meat (breast and thigh) stored under freezing during 6

months, the TBARS values ranged from 1 mg MDA/kg meat (1% grape seed extract) to 4.4 mg MDA/kg meat (control), being below the values found in the present study. This variation in the results may have occurred due to several factors, among them the variety of grape used, which may contain higher content of phenolic compounds; the quality and purity of the antioxidant added, since in that article, commercial grape seed extract of high-purity (89% of proanthocyanidins) was used; the cut of chicken used, as the thigh and drumstick poultry contains higher content of lipids than breast; and the methodology used for TBARS.

Despite the variation in results, both the present study and the research of Brannan and Mah [9] showed the same trend, as indicated by the reduction in the levels of TBARS. According to the results of these authors, after 6 months of freezing, the treatments with addition of grape seed extract reduced the TBARS values in 79% (1% of grape extract) and 62% (0.1% of grape extract) in relation to control. In this study, the sixth month of storage decreased approximately 67% (IE) and 65% (NE) of TBARS values, when compared to CNTL treatment, showing the effectiveness of grape seed extracts as a natural antioxidant in meat products.

B. Sensory evaluation

According to the means given by the panelists (Table 3), the addition of IE and NE promoted alteration in colour of the samples, as evidenced by statistical difference in relation to the control treatment at the third, sixth and ninth month of freezing. The treatments with addition of grape seed extract (IE and NE) always had the highest notes regarding change of colour, and that treatment with addition of Isabel grape seed extracts showed greater tendency to this change.

Table 3. Means of sensory attributes measured in cooked, vacuum packaging poultry meat and stored during frozen storage (9 months).

Treatment	Colour alteration			
	Month 0	Month 3	Month 6	Month 9
CNTL	$2,25^{abA}$	$2,03^{bA}$	$2,30^{bA}$	$1,95^{cA}$
BHT	$2,65^{abA}$	$1,75^{bA}$	$2,48^{abA}$	$2,26^{bcA}$
IE	$2,93^{abA}$	$4,85^{aA}$	$4,75^{aA}$	$4,47^{abA}$
NE	$1,80^{bA}$	$3,90^{abA}$	$3,36^{abA}$	$4,55^{aA}$
ERS	$4,38^{aA}$	$2,08^{abA}$	$2,90^{abA}$	$2,77^{abA}$
Treatment	Taste alteration			
	Month 0	Month 3	Month 6	Month 9
CNTL	$4,62^{aA}$	$2,89^{abA}$	$2,96^{aA}$	$4,00^{aA}$
BHT	$3,70^{aA}$	$2,52^{abA}$	$2,35^{aA}$	$2,93^{aA}$
IE	$3,83^{aA}$	$3,27^{abA}$	$1,85^{aA}$	$3,20^{aA}$
NE	$5,01^{aA}$	$4,71^{aA}$	$4,12^{aA}$	$4,63^{aA}$
ERS	$3,30^{aA}$	$2,09^{bA}$	$1,78^{aA}$	$1,81^{aA}$
Treatment	Odour alteration			
	Month 0	Month 3	Month 6	Month 9
CNTL	$2,89^{aA}$	$3,63^{aA}$	$2,50^{abA}$	$4,13^{aA}$
BHT	$1,64^{aA}$	$1,51^{aA}$	$1,59^{bA}$	$2,80^{aA}$
IE	$1,45^{aA}$	$1,35^{aA}$	$1,93^{abA}$	$2,74^{aA}$
NE	$1,98^{aA}$	$3,77^{aA}$	$3,34^{aA}$	$3,05^{aA}$
ERS	$1,35^{aA}$	$1,36^{aA}$	$1,87^{abA}$	$1,77^{aA}$

a, b, c Means within the same column with different letters are significantly different (P<0,05) by Tukey test.

A, B, C Means within the same row with different letters are significantly different (P<0,05) by Tukey test.

According to Chang and Peterson [10] compounds that develop during lipid oxidation do not only contribute to undesirable flavours, as well give a greenish aspect to the colour of the meat. In that way, the results of the present study are probably due to the action of additioned grape extract into the samples, which showed darker colour not as a result of the oxidative process, since the analysis of lipid oxidation in the third, sixth and ninth month storage, the sample CNTL showed higher TBARS values for both treatments with addition of grape extract.

Regarding the odour attribute, the sensory panel practically didn't detect alteration in the odour of the samples, except for the results presented in the sixth month of frozen storage. Already on the attribute taste alteration, after processing and after 6 and 9 months of freezing, the treatment didn't promote alteration of taste samples of cooked chicken, which is evidenced by not having made a significant difference between them ($p<0.05$). However, in the third month of freezing, the sensory panel detected significant alteration ($p<0.05$) of treatment NE, which had the highest note (4.71) in comparison to ERS.

Lau and King [11] evaluated the effect of grape seed extract on pre and post-mortem turkey

meat. The results of a preliminary sensory evaluation showed that the evaluators noted change in the odour of the samples with addition of grape seed extract (post-mortem meat), indicating the presence of wine odour. They also indicated a masking of the meat flavour and a slightly bitter residual taste. These results disagree with those from this study, where there was no change in the taste and odour attributes in almost all points of analysis.

IV. CONCLUSION

According to the results, the addition of Isabel and Niagara grape seed and peel extracts promoted satisfactory effect in protecting against lipid oxidation in processed, cooked and frozen poultry meat. However, the treatment with synthetic antioxidant BHT was still the most efficient in maintaining the oxidative stability of samples. As for sensory acceptance, the addition of the extracts promoted alteration in colour of the samples, but for odour and flavour attributes, there was almost no interference from treatments in cooked poultry meat.

ACKNOWLEDGEMENT

The authors acknowledge Fundação de Amparo a Pesquisa do Estado de São Paulo/FAPESP–Brasil for the finacial support, Cryovac for the supply of the packings and IBRAC for the supply of the additives.

REFERENCES

[1] R. A. Field, “Mechanically separated meat, poultry and fish,” in *Edible meat by-products*, vol. 5, A.M. Pearson, T.R. Dutson, Ed. New York: Elsevier, 1988, pp. 83-126.

[2] H. Verhagen, H. H. G. Beckers, P. A. W. V. Comuth, L. M. Maas, F. Tenhoor, P. T. Henderson, J. C. S. Kleinjans, “Disposition of single oral doses of butylated hydroxytoluene in man and rat,” *Food and Chemical Toxicology*, vol. 27, pp.765-772, Dec. 1989.

[3] G. Wurtzen, “Scientific evaluation of the safety factor for the acceptable daily intake (ADI) - Case study: butylated hydroxyanisole (BHA),” *Food Additivies and Contaminants*, vol. 10, pp. 307-314, May/Jun. 1993.

[4] D. Georgantelis, G. Blekas, P. Katikou, I. Ambrosiadis, and D. J. Fletouris, “Effect of rosemary extract, chitosan and α-tocopherol on lipid oxidation and colour stability during storage of beef burguers,” *Meat Science*, vol. 75, pp. 256-264, Feb. 2007.

[5] K. S. Rhee, Y. A. Ziprin, G. Ordonez, and C. E. Bohac, “Fatty acid profiles and lipid oxidation in pork muscles as affected by canola oil in the animal dieta and muscle location,” *Meat Science*, vol. 23, pp. 201-210, Jul. 1988.

[6] G. C. Yen, H. Y. Chen, and H. H. Peng, “Antioxidant and pro-oxidant effects of various tea extracts,” *Journal of Agricultural and Food Chemistry*, vol 45, pp. 30-34. Jan. 1997.

[7] G. Sorensen, S. S. Jorgensen, "A critical examination of some experimental variables in the 2-thiobarbituric acid (TBA) test for lipid oxidation in meat products,” *Zeitschrft fur Lebensmittel Untersuchung und forschung*, vol. 202, pp. 205-210, May 1996.

[8] W. Vyncke, “Evaluation of thiobarbituric direct extraction method for determining oxidative rancidity in mackerel (Scomber scombrus L.),” Fette Seifen Anstrichnittel, vol. 77, pp. 239-240, 1975.

[9] R. G. Brannan, and E. Mah, “Grape seed extract inhibits lipid oxidation in muscle from different species during refrigerated and frozen storage and oxidation catalyzed by peroxinitrite and iron/ascorbate in a pyrogallol red model system,” Meat Science, vol. 77, pp. 540-546, May 2007.

[10] S. S. Chang, and R. J. Peterson, “Recent developments in the flavor of meat,” Journal of Food Science, vol. 42, pp. 298-305, 1977.

[11] D. W. Lau, and A. J. King, “Pre-and post-mortem use of grape seed extract in dark poultry meat to inhibit development of thiobarbituric acid reactive substances,” Journal Agriculture Food and Chemistry, vol. 51, pp. 1602-1607. Mar. 2003.

.