



Natural anti-oxidants from agricultural by-products used in organic fish flesh

¹Ortoffi M., ¹Gai F., ²Lembo G., ¹Palmeiano G.B., ¹Peiretti P.G. and ¹Strazzullo G.

¹CNR Institute of Science of Food Production, Turin Division, via L. da Vinci 44, 10095 Grugliasco, Italy

²COISPA, Experimental Station for the Study of Resources of the Sea, Via dei Trulli 18, 70126 Bari, Italy

*Corresponding Author: FRANCESCO GAI; e-mail address: francesco.gai@ispa.cnr.it

Introduction

The main constraint in the production of organic foods is the use of antioxidants in order to preserve their biological value. Synthetic antioxidants, such as BHT, BHA and ethoxyquin, cannot be used in feed for the production of organic food, as provided by EC Reg 710/2009 and subsequent implementing regulations. In this light it becomes necessary to replace the synthetic compounds with analogs of natural origin. Secondary metabolites from plants and agricultural by-products (ABP) of the agro-food industry represent a good source of natural antioxidants with high added value.

Materials and Methods

DPPH assay: The antioxidant activity of the alcoholic extract of four different ABP was measured in an *in vitro* chemical system (DPPH assay) as free radical scavenging activity. The ABP tested were: **Red Grape Pomace** (*Vitis vinifera*, RGP), **Oil of Rosemary** (*Rosmarinus officinalis*, OR), **Hazel Nuts Leaves** (*Corylus avellana*, HNL) and **Tomato Pomace** (*Lycopersicon esculentum*, TP). The results of the antioxidant activity of selected ABP is showed in **Figure 1**.

Shelf-life assay: RGP, OR and HNL, showing the highest DPPH activity, were selected and tested as antioxidants directly using a fish (rainbow trout) *shelf-life* test, in order to evaluate their effects during fish flesh ice storage at 4°C.

Aqueous extracts of RGP and HNL were added to minced trout fillets at the concentration of 1 and 3% (v/w) and 1, 3 and 5% (v/w) respectively, while purified OR was tested in a concentration of 0.2, 1 and 3% (v/w). All extracts were compared with control groups (sterile deionised water).

The effectiveness of the antioxidant capacity of the extracts was evaluated in different days of storage analyzing lipid oxidation (as mg MDA/g of muscle, TBARS) as well as pH, color (L, a*, b*) and fatty acids (FAs) profile (as % of Total FA), as selected freshness indicators.

Statistical analysis: Data were evaluated by means of the GLM procedure of the SPSS software package, considering the treatment (T), days of storage (D) and their interaction (I) as the main effects. Significance was established at P<0.05.

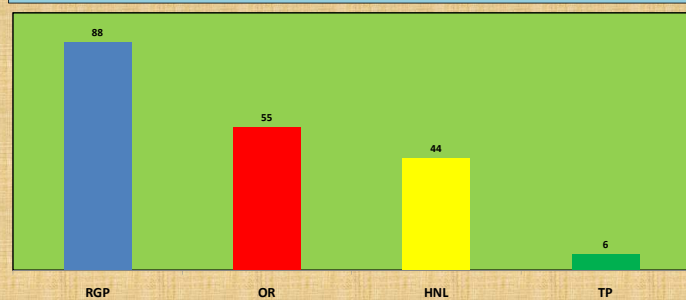


Figure 1. Antioxidant activity of ABP tested (DPPH %)

Results and Discussion

Results for fish *shelf-life* test of RGP, OR and HNL extracts are reported in table 1, 2 and 3, respectively.

RGP extracts treatment affected TBARS and color parameters, while pH and FAs were not affected. Fish flesh treated with RGP, at both concentrations, showed after six days of storage lower concentrations of MDA than the control group (0.7 vs 2.9).

Days of storage influenced all freshness indicators except FAs while an interaction has been determined in TBARS and redness (a*) parameter.

OR extracts treatment affected all parameters except the concentration of the FA C18:1n9. Fish flesh treated with OR 0.2% showed after nine days of storage lower concentrations of MDA than the control group (0.13 vs 0.23).

Days of storage influenced all freshness indicators except yellowness (b*) and the C18:1n9 concentration while an interaction has been determined in all parameter considered.

HNL extracts treatment affected all parameters except the redness (a*) parameter and the concentration of the FA C22:6n3. Fish flesh treated with HNL showed after six days of storage lower concentrations of MDA than control group.

Days of storage influenced all freshness indicators except redness (a*) and yellowness (b*) parameter while an interaction has been determined in TBARS, pH, redness (a*) and three of the main FAs.

Conclusion

Based on the results obtained, agricultural by-products revealed their high potential for exploitation. In conclusion, ABP represent a natural source of bio-active substances with antioxidant activity to be used as a food additive in the organic feed.

Acknowledgments

Financial support for this work was provided by the Ministero delle Politiche Agricole Alimentari e Forestali, Italy - **Project title: Azione concertata per l'identificazione di contributi scientifici per lo sviluppo dell'acquacoltura biologica in Italia - Acquacoltura biologica.**

Table 1. Effects of RGP extracts on minced fish flesh

Treatment	RGP 0%		RGP 1%		RGP 3%		* EFFECT
	1	6	1	6	1	6	
Days of storage							
TBARS	1.07	2.86	1.07	0.70	1.06	0.71	TDI
pH	6.78	6.64	6.76	6.61	6.47	6.56	D
L	65.5	61.0	56.2	51.3	52.0	47.1	TD
a*	5.13	0.07	5.95	2.56	6.96	4.70	TDI
b*	14.1	11.8	8.50	5.23	5.17	3.74	TD
Main FAs							
C16:0	16.8	16.9	16.6	16.8	16.4	16.5	n.s.
C18:1n9	15.4	15.2	15.9	15.1	16.8	15.8	n.s.
C18:2n6	12.3	11.5	12.5	12.0	13.8	12.7	n.s.
C20:5n3	5.8	5.5	5.6	5.6	5.5	5.5	n.s.
C22:6n3	24.6	26.0	25.1	26.2	22.2	24.5	n.s.

Table 2. Effects of OR extracts on minced fish flesh

Treatment	OR 0%		OR 0.2%		OR 1%		OR 3%		* EFFECT
	3	9	3	9	3	9	3	9	
Days of storage									
TBARS	0.41	0.23	0.27	0.13	0.19	0.18	0.90	0.26	TDI
pH	6.75	7.04	6.70	7.01	6.73	6.84	6.65	6.89	TDI
L	70.7	71.2	70.6	75.8	75.2	76.1	80.2	79.9	TDI
a*	2.66	2.72	3.01	2.79	1.31	2.51	0.79	0.29	TDI
b*	12.1	11.1	11.6	13.4	12.6	11.9	12.2	13.2	TI
Main FAs									
C16:0	20.0	15.6	20.0	11.9	15.2	12.8	14.7	14.7	TDI
C18:1n9	16.9	14.1	17.0	12.3	15.3	11.8	13.2	15.9	DI
C18:2n6	14.0	13.4	15.4	15.3	19.4	9.50	17.1	20.9	TDI
C20:5n3	2.0	2.6	2.1	3.5	6.3	1.1	6.3	5.9	TDI
C22:6n3	5.8	5.6	5.6	8.6	14.9	2.5	17.8	13.4	TDI

Table 3. Effects of HNL extracts on minced fish flesh

Treatment	HNL 0%		HNL 1%		HNL 3%		HNL 5%		* EFFECT
	3	6	3	6	3	6	3	6	
Days of storage									
TBARS	0.62	2.82	0.52	1.72	0.88	1.71	0.53	1.52	TDI
pH	6.26	6.40	6.19	6.35	6.25	6.29	6.25	6.24	TDI
L	73.8	73.4	72.2	71.6	72.1	70.9	72.3	71.4	TD
a*	3.76	3.15	3.08	3.45	3.22	3.52	3.29	3.79	I
b*	13.4	15.1	14.3	13.6	17.2	17.0	15.6	16.3	T
Main FAs									
C16:0	13.2	14.1	15.8	13.1	15.3	10.2	15.9	12.1	TD
C18:1n9	16.7	15.8	17.1	13.6	16.7	9.6	17.0	12.0	TDI
C18:2n6	16.8	15.9	16.8	14.4	17.6	9.9	16.8	12.8	TDI
C20:5n3	7.30	6.60	7.57	6.17	7.60	2.90	7.47	5.47	TDI
C22:6n3	16.2	14.6	16.7	14.8	16.8	12.9	16.1	14.4	D