Addition of Seaweed Polysaccharides from Brown Seaweed (*Laminaria digitata*) to Porcine Diets: Influence on the Oxidative Stability of Organ Tissues and Fresh Pork Quality

N.C. Moroney[1], M.N. O'Grady[1], J.V. O'Doherty[2], J.P. Kerry[1]

[1]Food Packaging Group, School of Food and Nutritional Sciences, College of Science, Engineering and Food Science, University College Cork, Ireland.

[2]School of Agriculture, Food Science, and Veterinary Medicine, College of Life Sciences, Lyons Research Farm, University College Dublin, Newcastle, Co. Dublin, Ireland.

INTRODUCTION

Macroalgae (seaweeds) contain a range of biologically diverse bioactive compounds with potential nutritional and health benefits for humans. The most abundant polysaccharides (soluble dietary fibre), in seaweeds are laminarin, fucoidan and alginic acid[2,3]. Laminarin is composed of β-(1,3)-D-glucan with β-(1,6) branching[2]. Fucoidan is a sulphated polysaccharide containing L-fucose[1,2]. Reported health benefits of laminarin and fucoidan include antitumor, antiviral, antibacterial and antioxidant activities[2,3]. The aim of this study was to assess the effect of supplementation of pig diets with a laminarin (500 ppm) (L) and fucoidan (420 ppm) (F) containing seaweed extract (L/F) on the oxidative stability of fresh pork striploin (*M. longissimus dorsi*) (LD steaks) and 25% organ (liver, heart, kidney and lung) tissue homogenates. The total antioxidant status (TAS) of porcine plasma was also determined.

RESULTS AND DISCUSSION

Plasma (TAS) ranged from 0.55-0.67 mmol/L plasma and was unaffected by dietary L/F. The surface colour (L*, a* and b* values) of LD steaks was unaffected by dietary L/F (data not shown). In general, levels of lipid oxidation followed the order: C > L/F-SD > L/F-WS indicating deposition of antioxidant components of L/F in the muscle (Figure 1). A statistically significant reduction in levels of lipid oxidation ($P < 0.05$) was observed in LD steaks from 75% of pigs (n = 6) fed L/F-WS compared to controls. Lowest levels of oxidation were observed in LD steaks from pigs fed the wet supplement (L/F-WS). Therefore spray drying during the manufacture of L/F-SD may have negatively affected the antioxidant capacity of the L/F supplement. All organ tissue homogenates were susceptible to iron (1mM $FeSO_4$) induced lipid oxidation after 24 hours storage, however heart, kidney and lung homogenates were unaffected by L/F supplementation (Table 1). Liver tissue homogenates had lower levels of lipid oxidation, relative to controls, as a result of dietary L/F supplementation. Microbiological analysis of LD steaks indicated that psychrotrophic and mesophilic plate counts increased over the 15 day storage period, however microbial growth was unaffected by dietary L/F (data not shown).

CONCLUSIONS

- Plasma (TAS), heart, kidney and lung tissue homogenates were unaffected by dietary L/F supplementation.
- The addition of a laminarin and fucoidan supplement (L/F) to porcine diets did not affect the surface colour or microbiology of fresh pork.
- Lower levels of lipid oxidation were observed in LD steaks and liver from pigs fed the L/F supplement.
- Results obtained demonstrate potential for dietary incorporation of marine derived bioactive antioxidant components into porcine muscle.
- Further research is necessary to examine the effects of dietary laminarin and fucoidan levels, form and duration of feeding on the quality and shelf-life of fresh pork.

REFERENCES

1. Bilan, M. I., Grachev, A. A., Shashkov, A. S., Nifantiev, N. E., and Usov, A. I. *Carbohydrate Research*. **2006,** 341, 238-245.
2. O'Doherty, J.V., Dillon, S., Figat, S., Callan, J. J., and Sweeny, T. *Animal Feed Science and Technology*. **2010,** 157, 173-180.
3. Ponce, M. A., Pujol, C. A., Damonte, E. B., Flores, M. L., and Stortz, C. A. *Carbohydrate Research*. **2003,** 338, 153-165.

MATERIALS AND METHODS

Laminaria digitata

L/F Extraction BioAtlantis Ltd

Wet-supplement **(L/F-WS)**

Spray-dried

Spray-dried supplement **(L/F-SD)**

Diets (3 weeks) Pigs (n = 24)

Control group

L/F-WS
500 ppm L
420 ppm F

L/F-SD
500 ppm L
420 ppm F

Measurements

Surface colour (LD steaks)

Lipid oxidation (LD steaks and organ tissue homogenates)

Microbiology (LD steaks)

Total Antioxidant Status (plasma)

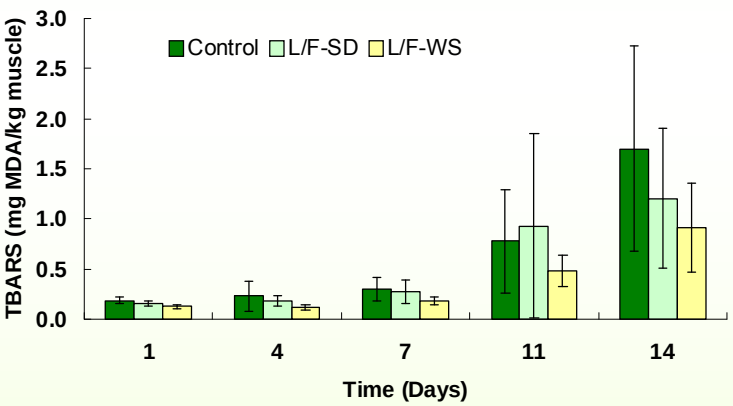

Figure 1. Lipid oxidation (TBARS, mean ± standard deviation) in fresh pork striploin (LD steaks) stored in MAP for up to 14 days at 4ºC.

Table 1. Iron-induced lipid oxidation in organ tissue homogenates after 24 hours storage at 4°C.

Treatment	Time (24 hours)			
	liver	heart	kidney	lung
Control	3.20 ± 1.43	3.26 ± 0.26	3.06 ± 1.01	2.99 ± 0.93
L/F-SD	1.99 ± 1.54	3.34 ± 0.27	2.26 ± 1.09	2.27 ± 1.82
L/F-WS	1.46 ± 1.36	3.28 ± 0.27	2.59 ± 0.52	2.96 ± 1.30

TBARS, Mean ± standard deviation.

ACKNOWLEDGEMENT: The Marine Functional Foods Research Initiative (NutraMara project) is a programme for marine based functional food development established by the Marine Institute and the Department of Agriculture, Fisheries and Food (DAFF). It is supported by funds provided under the Strategy for Science, Technology and Innovation 2006-2013 (SSTI) and the Food Institutional Research Measure (FIRM), to establish a Marine Functional Foods Research Programme.