

# Quality Evaluation of Salmonid Fillets in Response to Soy-based Diets

## YEAR 2

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Submitted by  
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The overall objective of our portion of the collaborative soybean study is to evaluate the quality of market sized rainbow trout and salmon reared on diets containing significant levels of soybean meal as a primary protein ingredient. In year 2, we completed the following: 1) quality evaluation of rainbow trout reared on experimental genistein-containing diets for 12 months, and 2) quality evaluation of rainbow trout reared on soy-containing diets.

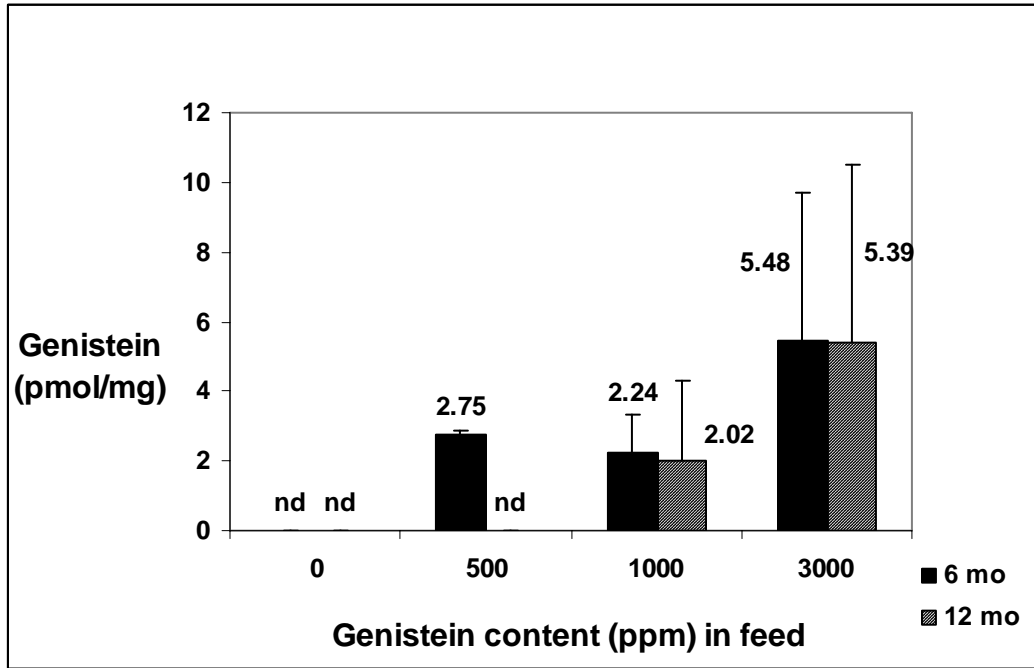
### ***Quality evaluation of rainbow trout fillets from fish fed genistein-containing feeds***

The objective of the second study was to evaluate the quality of rainbow trout reared on diets in which genistein was added as a component. Fish evaluated in this study were obtained from Jeff Malison's research team at the University of Wisconsin. Rainbow trout fingerlings having an average initial weight of < 5g each were placed into 12 tanks and fed one of four experimental feeds. The diets were formulated to contain either 0, 500 ppm, 1000 ppm, or 3000 ppm of genistein. After 6 months, some fish were killed and fillets were sent to the University of Maine for quality analyses in our laboratory. These data were presented in last year's report. The remaining fish were fed the same diets for an additional 6 months (12 months total) and then subjected to quality evaluation.

Quality evaluation of the fillets included genistein quantification, sensory evaluation by a consumer panel, proximate analyses (protein and moisture), and instrumental color analyses using a Hunter Lab Colorimeter. All fillets were from the same side of the fish and were analyzed in duplicate. One fillet from each of the two fish at a particular feed level was ground together in a blender for 45 seconds. The resulting mince was then used for estimation of genistein levels.

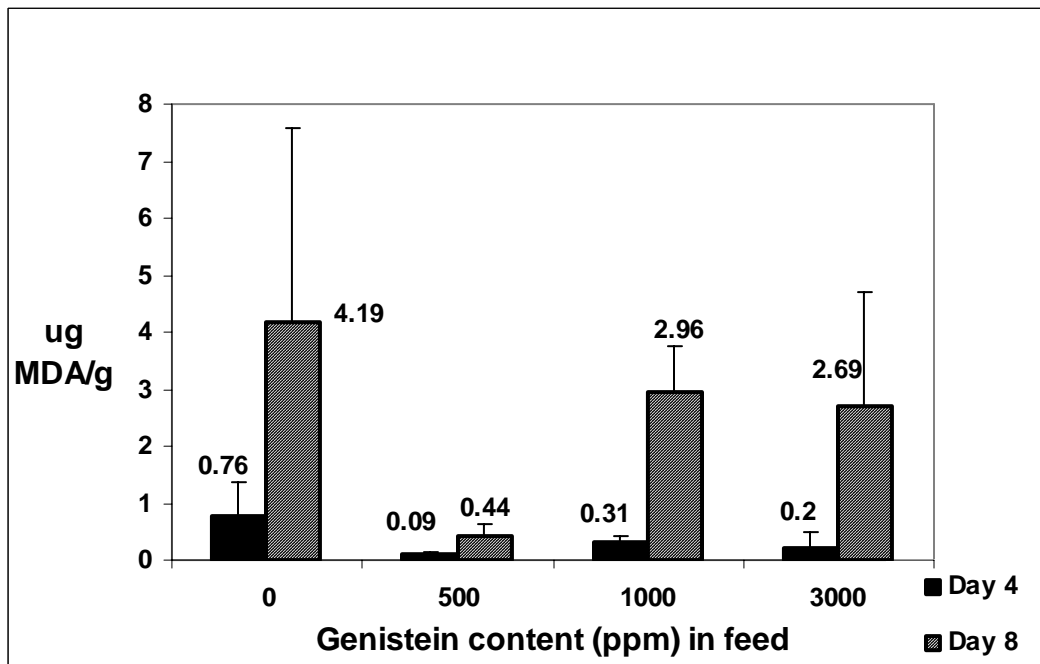
**Genistein:** Results indicate that genistein deposition in the fillets was significantly influenced by levels of genistein in the diet. The highest level of genistein, ~ 5.4 pmol/mg was found in the fillets from the trout fed the 3,000 ppm genistein diet (Figure 1) No genistein was detected in fillets from the 0 ppm genistein diet.

**Figure 1. Genistein content in rainbow trout tissues**



**Lipid oxidation:** Dietary genistein had a lowering effect on lipid oxidation in the refrigerated fillets (Figure 2). MDA levels on Day 4 and Day 8 were significantly higher (Figure 2) in the fillets from the 0 ppm genistein level than in fillets from the other dietary treatments. These results suggest that even dietary genistein levels of 500 ppm reduced the extent of lipid oxidation in the resultant fillets.

**Figure 2. Lipid oxidation (TBARS) levels in rainbow trout tissue**



**Proximates and color:** There was a significant decrease in moisture, ash and protein content in the fillets as fish matured (Table 1). However, diet did not have a significant effect on protein, ash, fat or moisture content of the fillets. For instrumental color, no significant differences in L, a, or b values were found between fillets from the different diets at both time periods studied. There was also no effect of time of harvest on the color of the fillets.

**Table 1. Proximate composition of rainbow trout fillets**

Genistein content (ppm) in feed	% Moisture		% Protein		% Fat		% Ash	
	6 mo	12 mo	6 mo	12 mo	6 mo	12 mo	6 mo	12 mo
0	75.8	75.8	74.4	73.4	13.1	14.8	6.9	5.1
500	77.5	73.9	76.0	71.2	n.a	n.a	n.a	n.a
1000	77.2	75.5	75.0	71.7	n.a	n.a	n.a	n.a
3000	76.8	74.9	73.0	72.3	14.1	16.4	6.3	4.9

**Sensory difference tests:** Triangle test panelists could not detect any significant differences between the trout fillets from the 0 ppm and the 3,000 ppm genistein treatments. For N=24, a total of 13 correct responses were required to conclude a significant difference at  $P \leq 0.05$ . However, only 5 correct responses were obtained for fish from the twelve-month growth period.

**Summary:**

Dietary genistein resulted in genistein deposition in fish flesh without adversely affecting the color, flavor or proximate composition of the fillets. TBARS values of the fillets during refrigerated storage were lower in genistein fed fish.

***Quality evaluation of rainbow trout reared on soy-containing diets***

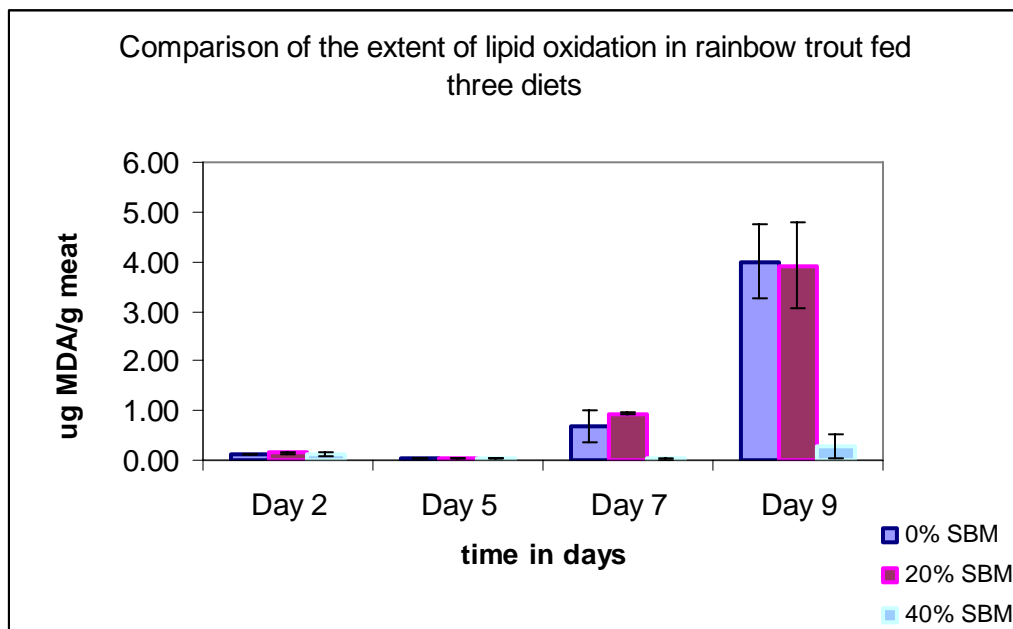
The objective of this study was to assess the effects of the soy-based diets on the quality of the fish fillets. Rainbow trout were grown at the University of Idaho, on three diets containing 0%, 20% or 40% soybean meal. There were two tanks for each diet. Trout were harvested after a period of 3 ½ months, gutted and filleted. Fillets were shipped overnight to University of Maine on ice. On arrival at the University of Maine (11/03/2004), fillets were rinsed in cold running water. Fillets for sensory evaluation were placed in Ziploc bags and frozen at -20 °C for 35 days. A ground sample for each tank was prepared from the remaining fillets after they were skinned.

The ground samples from each tank were analyzed for isoflavone (genistein and daidzein) content, color, thiobarbituric-acid reactive substances (TBARS), proximates and measurement of headspace volatiles.

**Isoflavone content:** Neither genistein nor daidzein were found to be deposited in the fillets from trout fed any of the three diets. Alternatively isoflavone concentrations may have been below detection limits.

**TBARS:** The fillets from trout fed the 40% soybean meal diet showed the lowest lipid oxidation, when stored in a refrigerator at 4°C for nine days (Figure 3). TBARS values on Day 9 for the trout fed the 40% SBM diet were significantly lower than the other two treatments.

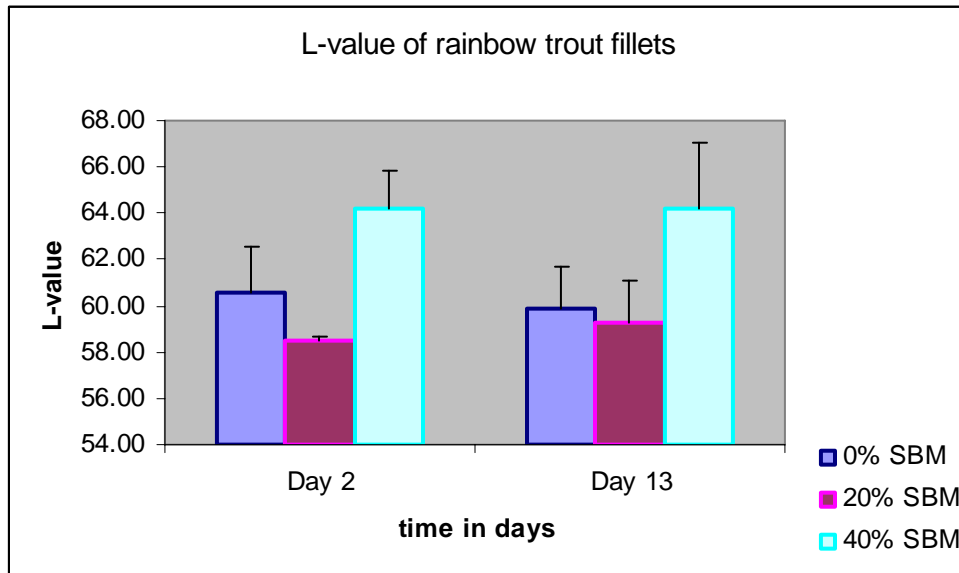
**Figure 3. Lipid oxidation (TBARS) in rainbow trout**



**Headspace analysis:** Amounts of propanal (a volatile oxidation product of fish lipids) found in the headspace of fillets of trout from all three diets were proportional to TBARS concentrations measured. Propanal concentrations found in headspace of trout from the 40% SBM diet treatment were lower than those found in headspace of trout fed either the 0% SBM or 20% SBM diets.

**Color:** The fillets from trout fed the 40% SBM diet were significantly whiter (*L*-value) in color than trout from the 0% and 20% SBM diets (Figure 4). ‘*A*’-value, which correlates with red intensity, significantly decreased over time for fillets from all three diets. There was no significant effects of percentage soy inclusion on the yellow color (*b* value) of the ground fillets.

**Figure 4. Instrumental color (L-value) of rainbow trout**



**Proximate analysis:** Trout fed the 20% SBM diet had significantly higher moisture content than trout fed the other two diets. No significant differences in fat, protein and ash content were found between trout fed the three diets.

#### **Sensory evaluation:**

*Difference testing* - Difference testing was carried out between trout patties made from ground trout fillet homogenate from trout fed the three diets. Panelists were served four sets of trout patties i.e. 0 vs. 20 (raw), 0 vs. 20 (cooked), 0 vs. 40 (raw) and 0 vs. 40 (cooked). Each set had three trout patties, two of which were from the same diet treatment and one from the other diet treatment. Panelists were asked to pick the odd one from the three samples presented in each set based on visual or aroma aspects for the raw; and for the cooked samples by tasting the patties. There were no significant differences between raw patties made from ground homogenate from the 0% SBM and those made from trout fed the 20% SBM diet. However, panelists could differentiate ( $P < 0.05$ ) between the cooked trout patties from the 0% vs 20% SBM treatments.

Again untrained panelists found a significant difference ( $P < 0.01$ ) between both raw trout patties from the 0% and 40% SBM diets and cooked patties from the 0% and 40% SBM diets. Raw trout patties from the 40% SBM diet were perceived as significant whiter than the other samples

*Acceptability testing* - The acceptability testing was performed on the 16<sup>th</sup> December between 12 - 4 pm. Fifty panelists participated in the study. Prior to the actual tasting, consumers were asked a few questions about eating habits. 35/50 said they consumed trout 1-10x a year. 24/50 panelists said they did not normally buy farm-raised fish. Consumers were served baked trout fillets from the three diet treatments and asked to rate how well they liked each fillet for color, texture, aroma, flavor, appearance and overall preference using a 9-point hedonic scale (1 = dislike intensely, 9 = like intensely). Although the trout from the 20% SBM diet received slightly higher scores than for the trout fed the 0% SBM and the 40% SBM diets on almost all attributes, there

were no significant differences ( $P>0.05$ ) in consumer acceptability ( $N = 50$ ) between baked trout fillets from trout fed the 0%, 20% and 40% SBM diets.

*Abstracts prepared:*

D'Souza, N., Skonberg, D.I, Hardy, R.W., and Brown, P. Effect of soybean meal-based diets on quality of rainbow trout and Atlantic salmon fillets. Prepared for the American Aquaculture Society Annual Meeting, New Orleans, LA, January 2005.

*Papers submitted:*

D'Souza, N., Skonberg, D.I, Camire, M.E., Malison, J., Guthrie, K. and Lima, L. Influence of dietary genistein levels on tissue genistein deposition and on the physical, chemical, and sensory quality of rainbow trout, *Oncorhynchus mykiss*. Journal of Agricultural and Food Chemistry.