



THESIS

**DEVELOPMENT OF AN EXTRUDED SNACK
SUPPLEMENTED WITH FISH PROTEIN
AND N-3 FATTY ACIDS**

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GRADUATE SCHOOL, KASETSART UNIVERSITY

2007

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FISH PROTEIN AND N-3 FATTY ACIDS**

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**A Thesis Submitted in Partial Fulfillment of
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Nantipa Pansawat 2007: Development of an Extruded Snack Supplemented with Fish Protein and n-3 Fatty Acids. Doctor of Philosophy (Agro-Industrial Product Development), Major Field: Agro-Industrial Product Development, Department of Product Development. Thesis Advisor: Associate Professor Anuvat Jangchud, Ph.D. 160 pages.

This research aimed to develop a nutritious snack and investigated the effects of extrusion on n-3 fatty acids. The survey showed the consumers were aware of n-3 fatty acids and willing to buy a snack containing n-3 fatty acid from fish oil. A formulation containing rice flour, fish powder, menhaden oil and vitamin E was extruded using a co-rotating twin-screw extruder. Extrusion variables were barrel temperature (125-145°C), screw speed (150-300 rpm) and feed moisture (19-23 g/100g db). Response surface methodology (RSM) was used to study the effects of extrusion conditions on eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and vitamin E contents, physical and sensory properties of extrudates. After extrusion, EPA+DHA contents reduced from 925 mg/100g to 702-948 mg/100g (80-102% retentions). EPA and DHA contents after extrusion were 278-358 mg/100g (71-94% retentions) and 433-591 mg/100g (80-108 % retention), respectively. The contour plots generated from second order polynomial models of EPA+DHA contents suggested that increased screw speed at low feed moisture and increased feed moisture at low screw speed increased EPA+DHA retention. The vitamin E contents (total tocopherols and tocotrienols) in the extrudates were 3.32-2.36 mg/100g (76.9-54.7% retentions). Higher retentions of vitamin E were found at high screw speed and high feed moisture. The contour plots revealed barrel temperature (125-145°C) had minimal affects on the EPA, DHA, and vitamin E retentions as well as the physical properties. The extrudates with low product density, high expansion ratio and low shear strength were found at high screw speed and low feed moisture. Higher degree of likeness in overall sensory characteristics of the extrudates rated by Asian untrained panelists was found at higher screw speed and lower feed moistures. The optimum extrusion conditions obtained by considering the EPA+DHA retentions and the overall liking scores were at the screw speed of 240-300 rpm and moisture content of 19.0-19.5 g/100g (db). The verification runs at conditions in the optimum region were successfully performed.

Student's signature

Thesis Advisor's signature

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