

**Utilization of *Sardinella longiceps* in a  
value added product development in the form of  
omega-3 enriched instant soup powder**

**by**

**Akurugoda Hewa Gamage Shanika Udari**

**Thesis submitted to the University of Sri Jayewardenepura  
for the award of the Degree of Masters of Science in Food  
Science & Technology**

## Declaration

The work described in this thesis was carried out by me under the supervision of Dr.Indira Wickramasinghe and Prof. M.V.E. Attygalle and report on this has not been submitted in whole or in part to any university or any other institution for another Degree.

*A.H.G.S.*  
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A.H.G.S Udari

08/12/2015  
.....

Date

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

  
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.....

Dr. Indira Wickramasinghe

Date

Senior Lecturer

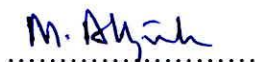
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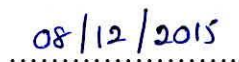
Faculty of Applied Science

University of Sri Jayewardenepura

Nugegoda,

Sri Lanka.

  
.....

  
.....

Prof. M.V.E. Attygalle

Date

Professor of Zoology

Department of Zoology

University of Sri Jayewardenepura

Nugegoda,

Sri Lanka.

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## ABBREVIATIONS

ALA	-	Alpha Linolenic acid
AOAC	-	AssosiationOf Analytical Communities
DHA	-	DocosaHexanoic Acid
EANS	-	European Academy of Nutritional Sciences
EPA	-	Eicosapentanoic Acid
FAME	-	Fatty Acid Methyl Esters
FDA	-	Food and Drug Administration
GDP	-	Gross Domestic Product
HDL	-	High Density Lipoproteins
ISO	-	International Organizationod Standardization
ISSFAL	-	International Society for the Study of Fatty Acids and Lipids
LDL	-	Low Density Lipoproteins
MUFA	-	Mono Unsaturated Fatty Acids
PUFA	-	Poly Unsaturated Fatty Acids
SFA	-	Saturated fatty acids
SLS	-	Sri Lanka Standards
UK	-	United kingdom
US	-	United Status

## ABSTRACT

“Indian Oil Sardine” or *Sardinella longiceps* is one of the most abundantly caught clupeoids under coastal pelagic fisheries in Sri Lanka. So far, there is no evidence of utilizing it in a possible value added food product efficiently even though it is available throughout the year and easily affordable at a low cost.

Most of the small pelagic fish like *Sardinella longiceps* are considered as best sources of Omega 3 polyunsaturated fatty acids. Yet, there are no studies have been done to assure whether these health friendly fatty acids are consumed as they are, when fish is cooked.

This study was designed to determine the effects of cooking on Omega 3 polyunsaturated fatty acids of *Sardinella longiceps* by comparing Gas chromatographic-mass spectroscopic fatty acid profiles of raw, boiled and fried fish; and then utilizing the fish in an innovative and value added product development emphasizing the enhancement of Omega 3 PUFA intake.

Omega 3 PUFA content of raw fish was 21.54% (of total fatty acids). With cooking, it has decreased and the resulted values were 14.23% and 2.83%, respectively in boiled and fried fish. Since average per capita fish consumption of Sri Lanka is 30.5 g, frying, which can be identified as the most popular cooking method of Sardines like small fish (due to lots of tiny bones present with lesser flesh), cannot provide the recommended minimum “EPA” Omega 3 intake (0.22 g per person) when taken alone without any other Omega 3 sources. As a solution for this issue, an instant soup powder which was incorporated with fish oil and fish powder derived from *Sardinella longiceps* was developed containing 9.31% of Omega 3 PUFA, which is significantly higher than that of fried fish. It can provide 0.6 g of EPA and 1.9 g of DHA per serving which are higher than the recommended values of minimum daily intake. As a whole or a part of a meal, an instant soup enriched with Omega 3 can be more nutritious and a convenient way to elevate the Omega 3 intake.

## CHAPTER 01

### INTRODUCTION

Sri Lanka, “The pearl of Indian Ocean”, is surrounded by Ocean and owning over 516,000 km<sup>2</sup> of Exclusive Economic Zone (EEZ) for fishing. Coastal pelagic fisheries have a higher consideration as the backbone of the fishing industry in Sri Lanka, which contribute about 26% of the total fish production in the country (Ministry of Fisheries and Aquatic Resources, 2008-2009).

Sardines, which are categorized under “Clupeoids”, always occur in dense and often very large schools containing many hundreds to thousands of fish, which is known as one of the most significant characteristics of them. “Indian Oil Sardine” or *Sardinella longiceps* is one of the most abundantly occurring Clupeoids, and are available throughout the year. Although post harvest loss in Sri Lankan fishery is considerably high; and this particular fish species is easily affordable with its low cost, still there is no evidence of utilizing it in a possible value added food product efficiently. Processing of low cost fish species into value added food products is one of the important food processing technologies.

Industrial interest in incorporating long chain omega-3 polyunsaturated fatty acids (omega-3 PUFA) into foods and dietary supplements is increasing since the last decade, with the growing body of evidence that these omega-3 PUFA have a number of health-beneficial effects in human physiology. According to guidelines formulated by the Food and Drug Administration (FDA) and other recognized bodies on Human Nutrition, the minimum average daily intake of Omega-3 PUFA (EPA + DHA) ranged between 0.2 g – 0.65 g per person.

Fish lipids contain a high proportion of long chain polyunsaturated fatty acids containing up to six double bonds. These PUFA in many fish lipids are dominated by two members of the omega-3 family, namely Eicosapentaenoic acid (EPA, C 20.5 ω3) and Docosahexaenoic acid (DHA, C 22.6 ω3). Regular consumption of fish which is considered as the best source of omega-3 EPA and DHA are believed to prevent and treat coronary heart disease and many other diseases. Most of the small pelagic fish such as Sardines, Mackerel, Salmon, Herring etc. contain around 30% of omega-3 polyunsaturated fatty acids in their total fatty acids profile (Edirisinghe *et al.*, 1998).

Although *Sardinella longiceps* is considered as a “High omega 3 fish”, due to the lesser flesh and high wastage, it is not much preferred to be prepared often by housewives. Its small size always encourages it to be “fried” than cooked in any other method, thus it is not acceptable to those who reject fried foods due to health concerns. Moreover, Due to the lower consumption of oily fish in many developed countries where a Western-style diet is predominant, the average fish intake is below than the recommended (Sanders, 2000). And even in Sri Lanka, a steady supply of fresh sardines is possible only across the coastal belt of the country, hence inland populations may lack the benefits from this valuable source.

An effort of development of innovative food product enriched with Omega-3 PUFA from *Sardinella longiceps* was carried out in this study. Without radical changes in eating habits and without much effort in preparation this product could elevate the omega-3 PUFA intake.

Instant soup is a very fast form of cookery and also famous among communities overall the world. The frantic rhythm of modern life has changed the food preparation methods

and obviously instant foods are preferred by consumers. And people have become more aware of healthy food and therefore, “Omega-3 enriched instant soup mix” would be a good and convenient nutritional choice. And also it comes as a dry product assuring longer period of shelf life than broth.

Soup powder consists of different ingredients, mostly corn starch, spices, salt and dehydrated vegetables other than fish powder and fish oil. Fish powder is prepared by dehydration of the edible parts of *Sardinella longiceps* while fish oil is extracted by cooking of edible parts of raw *Sardinella longiceps* followed by centrifuge and filtration to separate the oil. Corn starch provides carbohydrates and certain amino acids and dehydrated vegetables contain important vitamins and minerals. The antioxidant properties of spices play an important role in minimising oxidation of fats when incorporated with food systems. And also it adds healthier impact to the food, lowering the risk of cancers and having a cholesterol-lowering effect (Tapsell,2006).Therefore, beyond eating a single fish preparation, a soup would be more valuable as a complete meal which contains not only fish but also more ingredients together.

Simultaneously, the study compares the fatty acid profiles of raw fish, fried fish, boiled fish and also the developed product. This could be used to study the effect of cooking on the fatty acid composition of the *Sardinella longiceps* compared to the raw fish and also the extent and the effectiveness of enrichment of the developed instant fish soup powder with Omega-3 PUFA. This will add a useful portion of knowledge to the field of Human Nutrition and Dietary recommendations since there are no clear and adequate studies on the effect of cooking on fatty acid profile of *Sardinella longiceps*, recorded so far.