International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 14-05-2021, Accepted: 31-05-2021, Published: 15-06-2021
Volume 6, Issue 3, 2021, Page No. 100-106

Fatty acid composition of raw and different heat treatment of cooked Pangasius meat studied by Gas chromatography

S Kothandaperumal
Deparment of Fish, Processing Technology, Fisheries College and Research Institute, Thoothukudi, Tamil Nadu, India

Abstract
Pangasius catfish culture is widely practiced in India. It has low cost of production, fast growth rate and disease resistance, more freshness, Good market potential in interior areas, especially in restaurants and hotels but it has more fat and hence has an unusual odour, when consumed in processed form affects the marketability and further value addition Also the nutritional value of catfish lipids is low because of a small amount of n-3 family PUFA and high amount of MUFA and SFA. The SFA and Trans C18:1 MUFA can increase risk of chronic cardiovascular diseases that affects the heart, blood vessels, and brain. Effective processing method can get rid of the fat content in Pangasius catfish fillet and provide a good protein food for consumers. The present project is therefore proposed to develop a suitable preprocessing method for removal of fat from catfish fillets.
There are different methods of heat treatment such as microwave, grilled and steam methods were used to reduce in the SFA and MUFA content of fish fillets. The present research is proposed to Standardized the different time and temperature of cooking process of defatted fillets. This research proposed on study of saturated and mono-unsaturated fatty acid from different heat treatment meats.

Keywords: fatty acid, pangasius meat, gas chromatography

Introduction
Pangasius genus includes the catfish varieties that are commonly found in the south-east Asian region. It belongs to the family Pangasiidae. The most common variety of cultured fish is Pangasianodon hypophthalmus. This fish species is also called, Sutchi catfish, striped catfish, or Tra fish. Among all the freshwater species, Pangasius catfish is the world's fastest-growing species in aquaculture. Pangasius is now traded worldwide as skinless and boneless fillets popularly along with portions, steaks, fillets, and also as value-added products Jeyakumari et al., 2016; Thi et al., 2013). The fish attains a bodyweight of 1.2 to 1.3 kg rapidly within six months but usually harvested after eight months of culture. Pangasius fillets are a good substitute for white-fleshed fishes in the market due to their increasing acceptability and popularity; Pangasius is usually served in the European market as skinned and boneless frozen fillets (Noseda *et al.*, 2012), currently, these fillets exported to over 100 countries worldwide. Fillets were characterized by high moisture levels of 80% and low crude protein of 15.8% and lipid of 3.0% contents. Total lipids were characterized by low cholesterol levels of 40 mg/100 g, high percentages of saturated fatty acids (47.5%) of total fatty acid. Low percentages of polyunsaturated fatty acids (20%) are present in total fatty acids mainly represented by linoleic acid (60% of total polyunsaturated fatty acids).
There is different heat treatment were used to removal or reduced the fat content from Pangasius fillets. Three different methods such as microwave, grilled and steam methods were used. It is held by different time and same temperature to remove fat content from the fillets. Best time and temperature is best for analysis and standardized time and temperature for removal of SFA and MUFA and retain PUFA content.

Materials and Methods
Materials
Pangasius hypophthalmus were collected from Madurai AM fish farm and fish markets. The collected fishes were kept in insulated iceboxes. Insulated icebox prevents dehydration, and temperature fluctuation thus delays the spoilage of fish. Further, it is easy to handle. Flake ice produced by flake ice machine was used during fish transportation and processing purpose. Size of the ice for 2-3 cm level were produced to kept into the box and fish were spread on ice layer then carried out further steps.

Method
Preparation of dressed meat
The raw pangasius sp was collected from the market and washed with water. If any foreign material adhered to the outer surface, it was removed. Weight of the cleaned fish sp. was noted down. Removal of fins, head, Evisceration was carried out and further washed in clean water. The weight of dressed meat was noted down.

Cooking of pagasius fillets and pasta preparation
- Raw meat (pangasius sp)
- Dressed meat
- Washed with water
- Steam cooking (98 $^{\circ}C$ for 15 minutes)
- Microwave oven cooking (110 $^{\circ}C$ for 6 minutes)
- Grilled oven cooking (120 $^{\circ}C$ for 15 minutes)
- Reduced content of SFA and MUFA

Sampling procedure
Randomly samples were chosen and study of different time

and temperature was used to remove fat from the fillets. The time and temperature which gave better removal of fat is suitable for standardization of time and temperature. Samples were collected from raw fillets, microwave cooked meat, grilled meat, Steam cooked meat and analysis of fatty acid composition. Mainly focus on study of saturated and mono-unsaturated fatty acid from defatted fish meats.

Standardization time and temperature for defattening of Pangasius fillets

There are different methods of heat treatment used to remove or defatted of *Pangasius* fillets. The selected 50 gram of meat was done a heat treatment for three times by the same method. The microwave heat treatment, grilled and steam method were followed.

The microwave cooked method was done by domesticated micro oven instrument with the temperature of 110℃ for 4 minutes the fillet was not completely free from fat. I have done the same experiment again with the temperature of 110℃ for 5 minutes and the meat was not completely free from fat content. Again I have done the same experiment with the temperature of 110℃ for 6minutes and the meat was completely free from fat. The grilled method was done by domesticated grill oven instrument with the temperature of 120℃ for 5 and 10 minutes. This both experiment resulted in incomplete loss of fat. I've conducted same experimented again with the temperature of 120℃ for 15 minutes and the meat was completely free of fat content. The steam method was done by pressure cooker with the temperature maintained at 98±2℃ for 10,15 and 20 minutes. The meat was cooked for 10 minutes, and 15 minutes for completely loss of the fat content from the fillets and again the same experimented was done for 20 minutes and there were no good results found. So, this finalized the standard temperature and time for the defattening of pangasius fillets. The microwave experiment standardized temperature is at 110℃ for 6minutes, the grilled and steam method standardized temperature and time is 120℃ for15minutes and 98±2℃ for 15 minutes. it is suitable for further study purpose.

Microwave oven cooking

The domestic microwave oven was used for cooking of Pangasius fillets. Fillets were kept in the oven to reach the core temperature of 110℃ for 6minutes.

Grilled oven cooking

Grilled oven cooking was carried out in a prestige grilled oven. In this cooking method, the fillets were kept in the oven to reach the core temperature of 120℃ for 15 minutes.

Steam cooking

The steam cooker was used for this cooking method. The meat was kept in the cooker to reach the core temperature of 98±2℃ for 15 minutes.

Fatty acid composition analysed by Gas chromatography

Fatty acid is very important components of lipids content. GC is most common method it is used for analysis of fatty acid composition. The fatty acid is a complex structure it is contain more components of fatty acid such as acylglycerols, cholesterol esters, waxes and glycosphingolipds. It is extracted by use of saponification hydrolysis it is done by alkaline medium AOAC, 1990. The FAMEs are extracted by use of the methanol and boron trifluoride.

Extraction and methylation it is done by folch method are used to obtained the lipid components from the ten gram of fish samples. Esterification was done, take 250g lipid fraction it is dissolved in to toluene in the round bottom flask. Then, added 4ml sodium hydroxide and reflux for 5-10minutes until droplets of fat disappears. added 5ml of methanol and reflux for another 1min. cool the content and add 15ml of saturated sodium chloride solution. then, add 5ml of hexane, shake well and then remove the upper layer hexane layer. Repeat the extraction with hexane twice. it is combine hexane layer and evaporate to dryness in a rotary flask evaporator set at 55-60℃. The methyl esters in 1ml of HPLC grade hexane for injection in GC. The column at 210℃ for 30minutes. then, inject 0.5ml of standard FAMEs mixture onto the GC. Then, it is start to separation of FAMEs takes 45min.

Next, inject 0.5ml of sample FAMEs. Identify the individual fatty acid in the sample by comparing the retention time of the individual fatty acid in the standard mixture. Calculated area unit value expressed to percentage of the fatty acid of total lipids.

Statistical Analysis

The SPPS 19 (IBM, 2O10) statistical package was used for analysis of experimental results. The results were produced in the mean standard deviation.

Result and Discussion

Fatty acid composition of defatted Pangasius meat

Fatty acid composition of raw Pangasius meat

The present study was used as gas chromatography to estimate Different portions fat from fish meat and their study of fatty acid composition. Raw Pangasius meat contains head portion of saturated fatty acid-53.04%, mono-unsaturated fatty acid-40.7% and poly-unsaturated fatty acid-7.06%. Body portion of saturated fatty acid-51.77%, mono-unsaturated fatty acid-40.44% and poly-unsaturated fatty acid-7.06%. Ventral portion of saturated fatty acid-50.37%, mono-unsaturated fatty acid-40.47% and poly-unsaturated fatty acid-7.07%. Tail portion of saturated fatty acid-46.79%, mono-unsaturated fatty acid-39.83% and poly-unsaturated fatty acid-6.94%.

Table 1: Fatty acid composition of Pangasius fillets

Compounds	Fatty acids	Raw head portion	Raw body portion	Ventral portion	Tail portion
C 4:0	Butyric acid	0.46	0.47	0.44	0.39
C 12:0	Lauric acid	0.42	0.3	0.35	0.2
C 14:0	Myristic acid	7.20	7.15	6.87	5.38
C 14:1	Myristoleic acid	0.91	0.73	0.84	0.87
C 15:0	Pentadecanoic acid	0.18	0.37	0.24	0.42

C 15:1	Cis-10 Pentadecanoic acid				
C 16:0	Palmitic acid	34.23	34.62	33.78	32.16
C 16:1	Palmitoleic acid	1.85	1.91	1.97	1.89
C 17:0	Heptadecanoic acid	0.16	0.18	0.24	0.14
C 17:1	Cis-10 Heptadecanoic acid	0.00	0.16	0.15	0.18
C 18:0	Stearic acid	6.74	6.98	6.34	6.25
C 18:1t	Vaccenic acid	36.64	36.48	35.21	35.78
C 18:2t	Linolelaidic acid	4.86	4.78	4.63	4.79
C 18: 2 n6c	Linoleic acid	0.16	0.19	0.21	0.14
C 18:3n3	α-Linolenic acid	0.34	0.49	0.41	0.31
C 13:3 n6	ϒ-Linolenic acid	0.25	0.29	0.31	0.28
C 20:1	Cis-11 Eicosenoic acid	1.14	1.16	1.17	1.11
C 20:2	Eicosadienoic acid	0.2	0.23	0.25	0.19
C 20:4n6	Arachidonic acid	1.25	1.08	1.26	1.23
C 20:3	Dihomo-γ-linolenic acid	0.00	0.00	0.00	0.00
C 21:0	Henicosanoic acid	2.26	0.41	0.6	0.58
C 22:0	Behenic acid	0.17	0.19	0.21	0.15
C 22:1n9	Erucic acid	0	0	0	0
C 22:2	Docosadienoic acid	0	0	0	0
C 22:6n3	Docosahexanoic acid	0	0.0	0.0	0.0
C 23:0	Tricosanoic acid	0.05	0.07	0.09	0.03
C 24:0	Lignoceric acid	1.10	1.03	1.21	1.09
C 24:1	Nervonic acid	0	0.0	0.0	0.0
Unknown		4.39	0.73	1.04	4.44
Total		100	100	100	100
Samples		Raw meat head portion	Raw body portion	Raw ventral region	Raw tail portion
Saturated fatty acids		53.04	51.77	50.37	46.79
Mono-unsaturated fatty acids		40.7	40.44	40.47	39.83
Poly-unsaturated fatty acids		7.06	7.06	7.07	6.94

Microwave heat treatment

Microwave cooking instruments able to scorching a material to be cooked. This apparatus was maintained under hygienic condition and operated in safe manner. It cooks the material without excessive heating of interior portion of the materials. These were used as home appliance. The recent investigation replaced that the microwave cooking apparatus replace conventionally processing technology such as pasteurizing (or) sterilizing food products (Ahmed & Ramaswamy 2007) [2]. Application of microwave heat into food products was invented by (Fito, P et., al 2005, Decareau 1985) [3]. In general, fish muscle protein was highly sensitive to microwave oven and texture of meat become it very dry, hard and rubbery appearance due to heated with elevated temperature (Mizrahi 2012) [4]. Microwave cooking of meat in higher temperature results in loss of nutrition from fish fillets (Shimi 1992) [5]. Cook-chilled products it can be vary in wide range of 6 – 42 days it is depending upon the heat treatment (Ahmed & Ramaswamy 2007) [2]. The raw fish fillets contain high fat content, but after heat treatment fat content reduced due to production of primary and secondary oxidative products in during microwave heat treatment (Regulska-Iiow & Iiow 2002).

Mineral composition was very important for health life.

The present research proposed to The microwave cooked method was done by domesticated micro oven instrument with the temperature of 110$^{\circ}C$ for 6minutes and the meat was completely free from fat. This method was reduced the saturated and mono-unsaturated fatty acids from the fillets. Raw Pangasius meat contains head portion of saturated fatty acid-53.04%, mono-unsaturated fatty acid-40.7% and poly-unsaturated fatty acid-7.06%. Body portion of saturated fatty acid-51.77%, mono-unsaturated fatty acid-40.44% and poly-unsaturated fatty acid-7.06%.

Ventral portion of saturated fatty acid-50.37%, mono-unsaturated fatty acid-40.47% and poly-unsaturated fatty acid-7.07%.

Tail portion of saturated fatty acid-46.79%, mono-unsaturated fatty acid-39.83% and poly-unsaturated fatty acid-6.94%. Microwave heat treatment was used to reduce saturated and mono-unsaturated fatty acids and retention of poly-unsaturated fats after defatted meats.

PUFA was increased after heat treatment. The proximate composition has increase the protein and ash content while decrease the moisture and fat contents. Mineral composition was increase after heat treatment.

Table 2: Fatty acid composition of Pangasius fillets

Compounds	Fatty acids	Head	Body portion	Ventral portion Micro.	Tail portion
C 4:0	Butyric acid	0.03	0.01	0.04	0.01
C 12:0	Lauric acid	0.02	0.04	0.06	0.03
C 14:0	Myristic acid	4.23	4.15	4.28	4.08
C 14:1	Myristoleic acid	0.09	0.06	0.07	0.04
C 15:0	Pentadecanoic acid	0.21	0.19	0.25	0.20
C 15:1	Cis-10 Pentadecanoic acid	0.02	0.03	0.03	0.01
C 16:0	Palmitic acid	23.19	23.48	24.19	23.61
C 16:1	Palmitoleic acid	2.08	2.03	2.07	2.04
C 17:0	Heptadecanoic acid	0.25	0.32	0.39	0.33

C 17:1	Cis-10 Heptadecanoic acid	0.18	0.16	0.19	0.12
C 18:0	Stearic acid	6.43	6.66	6.69	6.18
C 18:1t	Vaccenic acid	34.12	34.43	34.28	34.14
C 18:2t	Linolelaidic acid	5.13	5.51	5.67	5.27
C 18: 2 n6c	Linoleic acid	0.17	0.14	0.19	0.13
C 18:3n3	α-Linolenic acid	0.58	0.54	0.57	0.51
C 13:3 n6	ϒ-Linolenic acid	0.25	0.21	0.27	0.28
C 20:1	Cis-11 Eicosenoic acid	1.15	1.17	1.16	1.12
C 20:2	Eicosadienoic acid	0.52	0.56	0.62	0.57
C 20:4n6	Arachidonic acid	0.47	0.44	0.46	0.42
C 20:3	Dihomo-γ-linolenic acid	0.08	0.06	0.07	0.05
C 21:0	Henicosanoic acid	0.7	0.6	0.9	0.5
C 22:0	Behenic acid	0.52	0.56	0.58	0.54
C 22:1n9	Erucic acid	0.24	0.21	0.25	0.23
C 22:2	Docosadienoic acid	0.02	0.04	0.07	0.01
C 22:6n3	Docosahexanoic acid	0.25	0.27	0.26	0.23
C 23:0	Tricosanoic acid	0.04	0.03	0.06	0.02
C 24:0	Lignoceric acid	0.4	0.41	0.32	0.28
C 24:1	Nervonic acid	0.63	0.65	0.64	0.61
Unknown		18	17.04	15.37	18.44
Total		100	100	100	100
Samples		cooked meat of head portion	Cooked meat of body portion	Ventral region	Tail portion
Saturated fatty acids		36.02	36.77	37.76	35.78
Mono-unsaturated fatty acids		38.51	38.74	38.69	38.08
Poly-unsaturated fatty acids		7.39	7.73r	8.18	7.47

Grilled method

In Grill, heat was produced and discharged through a tube which was used to cook the food. Grill microwave oven is suitable for reheating, cooking and grilling the various food items. The oven was maintained with preheat oven temperature up to 275F. Based on cooking process.

it will take time to cooking the food is depending upon the cooking process, it may have need for 20 -30 minutes. The fish products can be prepared by various cooking methods such as boiled, grilled, fried and baked and their particularly study about grilled oven methods (Lee 1991) [16]. Study about preparation by grill oven method. Proximate composition of grilled fish products was studied by (Bochi et al., 2008) [15, 23] In case low fat fish moisture and fat content does not affected by grilling methods and their also does not affected the chemical composition of final products (Dreeling et al., 2000) [17]. The minerals content can be affected during cooking time it was reported by (Kucukgulmez et al., 2006) [18]. The present research proposed to defattening of Pangasius fillets were used by under grill oven at maintain the temperature 120$^{\circ}C$ for 15 minutes. After heat treatment the SFA and MUFA content was reduced and mineral composition was increased. The proximate composition was increase the protein and ash while decrease the moisture and fat content. Raw Pangasius meat contains head portion of saturated fatty acid-53.04%, mono-unsaturated fatty acid-40.7% and poly-unsaturated fatty acid-7.06%. Body portion of saturated fatty acid-51.77%, mono-unsaturated fatty acid-40.44% and poly-unsaturated fatty acid-7.06%. Ventral portion of saturated fatty acid-50.37%, mono-unsaturated fatty acid-40.47% and poly-unsaturated fatty acid-7.07%. Tail portion of saturated fatty acid-46.79%, mono-unsaturated fatty acid-39.83% and poly-unsaturated fatty acid-6.94%. Grilled heat treatment was used to reduce saturated and mono-unsaturated fatty acids and retention of poly-unsaturated fats after defatted meats. The proximate composition was increase the protein and ash while decrease the moisture and fat content.

Table 3: Fatty acid composition of Pangasius fillets

Compounds	Fatty acids	Head portion	Body portion	Ventral portion	Tail portion
C 4:0	Butyric acid	0.13	0.12	0.10	0.11
C 12:0	Lauric acid	0.14	0.11	0.13	0.15
C 14:0	Myristic acid	4.42	4.45	4.41	4.47
C 14:1	Myristoleic acid	0.06	0.04	0.07	0.05
C 15:0	Pentadecanoic acid	0.40	0.42	0.44	0.43
C 15:1	Cis-10 Pentadecanoic acid	0.24	0.21	0.23	0.26
C 16:0	Palmitic acid	29.45	29.56	29.34	29.83
C 16:1	Palmitoleic acid	1.61	1.63	1.60	1.65
C 17:0	Heptadecanoic acid	0.43	0.41	0.44	0.42
C 17:1	Cis-10 Heptadecanoic acid	0.14	0.16	0.13	0.15
C 18:0	Stearic acid	8.18	8.27	8.53	8.25
C 18:1t	Vaccenic acid	35.13	35.27	35.54	35.35
C 18:2t	Linolelaidic acid	5.17	5.24	5.43	5.27
C 18: 2 n6c	Linoleic acid	0.14	0.13	0.15	0.12
C 18:3n3	α-Linolenic acid	0.85	0.82	0.80	0.83
C 13:3 n6	ϒ-Linolenic acid	0.15	0.14	0.13	0.16
C 20:1	Cis-11 Eicosenoic acid	0.62	0.60	0.64	0.63
C 20:2	Eicosadienoic acid	0.54	0.52	0.50	0.54

C 20:4n6	Arachidonic acid	0.41	0.44	0.46	0.43
C 20:3	Dihomo-γ-linolenic acid	0.19	0.17	0.18	0.15
C 21:0	Henicosanoic acid	0.55	0.53	0.52	0.51
C 22:0	Behenic acid	1.31	1.35	1.33	1.32
C 22:1n9	Erucic acid	0.54	0.51	0.55	0.53
C 22:2	Docosadienoic acid	0.03	0.04	0.02	0.01
C 22:6n3	Docosahexanoic acid	0.24	0.26	0.28	0.23
C 23:0	Tricosanoic acid	0.1	0.3	0.5	0.2
C 24:0	Lignoceric acid	0.42	0.41	0.40	0.44
C 24:1	Nervonic acid	0.86	0.84	0.87	0.83
Unknown		7.55	7.05	6.28	6.68
Total		100	100	100	100
Samples	Grilled head portion	grilled body portion		Grilled ventral portion	Grilled tail portion
Saturated fatty acids	45.53	45.93		46.14	46.13
Mono-unsaturated fatty acids	39.20	39.26		39.63	39.45
Poly-unsaturated fatty acids	7.72	7.76		7.95	7.74

Steam cooked method

Steaming method provides desirable sensory property and loss of minimum content of nutrients and their also destruction of microorganism. At the time of cooking of fish meat contained water, physical and chemical properties get changed. They also increasing digestibility due to denaturation of proteins and PUFAs content get reduced in during heat treatment (Raj et al., 2008; Asmah et al., 2014) [19, 28]. (Nurhan, 2007) observed that the cooking process affects the amino acid content. The various fish fatty acid profile can be affected by various cooking methods it was reported given by (Nurhan 2007; Weber et al., 2008; Larsen et al., 2010; Koubaa et al., 2012; Sengor et al., 2013; Asmah et al., 2014; Neff et al., 2014) [21, 15, 23, 24, 25, 28, 27]. The superheated steams have clear and colorless steams can be generated from steam at 100°c.

This steam produced in high temperature and compared with saturation boiling point and their normally cooking in the without presence of oxygen (Ezhil, 2010) [29]. This type of heat treatment reduced the lipid content and retain vitamins C, and their preserve the colour and texture of various food products (Idrus & Yang, 2012) [30]. The cooking can be reducing the minimum amount of amino acids and PUFAs in the fish meat and their also determination the super-heated steam cooking are influence into fish nutritional composition which has include in proximate composition, fatty acid and amino acid composition. The present research proposed to use of steam cooking method were held by the use of normal stainless vessel to filled water covered with perforated plate then fillets were kept on the plate it was maintain 98°c for 15 minutes. Fatty acid composition was affected after heat treatment. The SFA and MUFA content were reduce while increase the PUFA content. Mineral and proximate composition was increased. Raw Pangasius meat contains head portion of saturated fatty acid-53.04%, mono-unsaturated fatty acid-40.7% and poly-unsaturated fatty acid-7.06%. Body portion of saturated fatty acid-51.77%, mono-unsaturated fatty acid-40.44% and poly-unsaturated fatty acid-7.06%. Ventral portion of saturated fatty acid-50.37%, mono-unsaturated fatty acid-40.47% and poly-unsaturated fatty acid-7.07%. Tail portion of saturated fatty acid-46.79%, mono-unsaturated fatty acid-39.83% and poly-unsaturated fatty acid-6.94%. Steam heat treatment was used to reduce saturated and mono-unsaturated fatty acids and retention of poly-unsaturated fats after defatted meats.

Table 4: Fatty acid composition of Pangasius fillets

Compounds	Fatty acids	Head portion	Body portion	Ventral portion	Tail portion
C 4:0	Butyric acid	0.12	0.32	0.24	0.15
C 12:0	Lauric acid	0.00	0.00	0.00	0.00
C 14:0	Myristic acid	5.45	5.64	5.36	5.38
C 14:1	Myristoleic acid	0.00	0.00	0.00	0.00
C 15:0	Pentadecanoic acid	0.34	0.36	0.33	0.31
C 15:1	Cis-10 Pentadecanoic acid	-	-	-	-
C 16:0	Palmitic acid	31.45	31.53	31.54	31.33
C 16:1	Palmitoleic acid	1.92	1.94	1.91	1.90
C 17:0	Heptadecanoic acid	0.43	0.46	0.42	0.41
C 17:1	Cis-10 Heptadecanoic acid	-	-	-	-
C 18:0	Stearic acid	7.37	7.58	7.47	7.33
C 18:1t	Vaccenic acid	36.04	36.06	36.03	36.01
C 18:2t	Linolelaidic acid	6.16	6.18	6.09	6.04
C 18: 2 n6c	Linoleic acid	0.18	0.16	0.19	0.15
C 18:3n3	α-Linolenic acid	0.59	0.57	0.55	0.54
C 13:3 n6	ϒ-Linolenic acid	0.13	0.15	0.16	0.12
C 20:1	Cis-11 Eicosenoic acid	1.15	1.14	1.17	1.11
C 20:2	Eicosadienoic acid	0.56	0.54	0.52	0.53
C 20:4n6	Arachidonic acid	0.25	0.27	0.23	0.24
C 20:3	Dihomo-γ-linolenic acid	-	-	-	-
C 21:0	Henicosanoic acid	0.52	0.54	0.50	0.53
C 22:0	Behenic acid	0.94	0.95	0.97	0.93
C 22:1n9	Erucic acid	0	0	0	0

C 22:2	Docosadienoic acid	0.03	0.01	0.04	0.02
C 22:6n3	Docosahexanoic acid	0.26	0.24	0.22	0.23
C 23:0	Tricosanoic acid	0	0	0	0
C 24:0	Lignoceric acid	0.33	0.31	0.34	0.31
C 24:1	Nervonic acid	0.83	0.85	0.85	0.80
Unknown		3.7	2.06	12.18	1.99
Total		100	100	100	100
Samples	cooked meat of head portion		Cooked meat of body portion	Ventral region	Tail portion
Saturated fatty acids	46.95		47.69	47.17	46.68
Mono-unsaturated fatty acids	39.94		39.99	39.96	39.82
Poly-unsaturated fatty acids	8.16		7.88	8.00	7.87

Conclusion

There are three different heat treatment such as microwave, grilled and steam method used to remove saturated and mono-unsaturated fatty acid from the Pangasius fillets. PUFA was retain the cooked fillets. Standardized of time and temperature of microwave cooked fillets held by IFB 25L convection microwave oven. Meat characteristics of well completed drop out fat content from cooked fillets at standard time 6 minutes and temperature 110°c. 5 g of fat was collected from 50g meat. Grilled fillets standardization time and temperature is 120°c for 15 minutes. Average calculated fat content of 4 g from 50g of meat. This method was held by domesticated prestige grill oven. Steam method fillets standardized time is 15 minutes at 98±2℃ °c. The fat collected was 8 grams from 50 g fillets. Standardized fillets are utilized for analysis of nutritional composition.

Meat characteristics of well completed drop out fat content from cooked fillets at standard time 6 minutes and temperature 110°c. 5 g of fat was collected from 50g meat. Microwave cooked head, body, ventral and tail portion samples has given percentage of up to 53.04%, 51.77%, 50.37% and 46.79% after heat treatment there is a loss 17.02%, 15%, 12.61% and 11.01% of the saturated fatty acid. The MUFA content of the raw head, body, ventral and tail fillets constitutes the amount of up to 40.7%, 40.44%, 40.47 and 39.83% after heat treatment of the microwave cooked samples has given compatible result of the amount of the 38.51%, 38,74%,38.69% and 38.08%. After heat treatment there could be change in content and lost composition of the fatty acid which represents the amount of up to 2.19%, 1.7%, 1.78% and 1.75%. PUFA content is increased after heat treatment such as the steam method and it established good result from 7.06 to 8.18% representing the samples. The heat treated samples showed the change in the composition and it constituted the increased in the concentration of the PUFA of the fillets and is found to be in the range of up to 1.12%. Meat characteristics of well completed drop out fat content from cooked fillets at standard time 15 minutes and temperature 120°c. 5 g of fat was collected from 50g meat. Grilled cooked head, body, ventral and tail portion samples has given percentage of up to 53.04%, 51.77%, 50.37% and 46.79% after heat treatment there is a loss 7.51%, 5.84%, 4.23% and 0.66% of the saturated fatty acid. The MUFA content of the raw head, body, ventral and tail fillets constitutes the amount of up to 40.7%, 40.44%, 40.47 and 39.83% after heat treatment of the microwave cooked samples has given compatible result of the amount of the 38.51%, 38,74%,38.69% and 38.08%. After heat treatment there could be change in content and lost composition of the fatty acid which represents the amount of up to 1.5%, 1.18%, 0.84% and 0.38%. PUFA content is increased after heat treatment such as the steam method and it established good result from 7.06 to 7.95% representing the samples. The heat treated samples showed the change in the composition and it constituted the increased in the concentration of the PUFA of the fillets and is found to be in the range of up to 0.88%. Steam cooked head, body, ventral and tail portion samples has given percentage of up to 53.04%, 51.77%, 50.37% and 46.79% after heat treatment there is a loss 6.09%, 4.08%, 3.2% and 0.11% of the saturated fatty acid. The MUFA content of the raw head, body, ventral and tail fillets constitutes the amount of up to 40.7%, 40.44%, 40.47 and 39.83% after heat treatment of the microwave cooked samples has given compatible result of the amount of the 38.51%, 38,74%,38.69% and 38.08%. After heat treatment there could be change in content and lost composition of the fatty acid which represents the amount of up to 0.76%, 0.45%, 0.51% and 0.01%. PUFA content is increased after heat treatment such as the steam method and it established good result from 7.06 to 8.18% representing the samples. The heat treated samples showed the change in the composition and it constituted the increased in the concentration of the PUFA of the fillets and is found to be in the range of up to 1.09%.

Reference

1. Jeyakumari A, Janarthanan G, Chouksey MK, Venkateshwarlu G. Effect of fish oil encapsulates incorporation on the physico-chemical and sensory properties of cookies. Journal of food science and technology,2016:53(1):856-863.
2. Ahmed J, Ramaswamy HS, Ayad A, Alli I, Alvarez P. Effect of high-pressure treatment on rheological, thermal and structural changes in Basmati rice flour slurry. Journal of Cereal Science,2007:46(2):148-156.
3. Fito P, Chiralt A, Martin ME. Current state of microwave applications to food processing. Novel food processing technologies,2005, 525-537.
4. Mizrahi S. Mechanisms of objectionable textural changes by microwave reheating of foods: a review. Journal of food science,2012:77(1):R57-R62.
5. El-Shimi NM. Influence of microwave and conventional cooking and reheating on sensory and chemical characteristics of roast beef. Food chemistry,1992:45(1):11-14.
6. Regulska-Ilow B, Ilow R. Comparison of the effects of microwave cooking and conventional cooking methods on the composition of fatty acids and fat quality indicators in herring. Food/Nahrung,2002a:46(6):383-388.
7. Long NV, Yang Y, Thi CM, Van Minh N, Cao Y. The development of mixture, alloy, and core-shell nanocatalysts with nanomaterial supports for energy conversion in low-temperature fuel cells. Nano Energy,2013:2(5):636-676.
8. Noseda B, Islam MT, Eriksson M, Heyndrickx M, De

Reu K, Van Langenhove H, Devlieghere F. Microbiological spoilage of vacuum and modified atmosphere packaged Vietnamese Pangasius hypophthalmus fillets. Food Microbiology,2012:30(2):408-419.
9. Noseda B, Islam MT, Eriksson M, Heyndrickx M, De Reu K, Van Langenhove H et al. Microbiological spoilage of vacuum and modified atmosphere packaged Vietnamese Pangasius hypophthalmus fillets. Food Microbiology,2012a:30(2):408-419.
10. AOAC, AOAC Official methods of analysis, 2000.
11. Kjeldahl C. A new method for the determination of nitrogen in organic matter. Z Anal Chem,1883:22:366.
12. Folch J, Lees M, Stanley GS. A simple method for the isolation and purification of total lipides from animal tissues. Journal of biological chemistry,1957:226(1):497-509.
13. Gall KL, Otwell WS, Koburgier JA, Appledorf H. Effects of four cooking methods on the proximate, mineral and fatty acid composition of fish fillets. Journal of Food Science,1983:48(4):1068-1074.
14. Kremelberg D. Practical statistics: A quick and easy guide to IBM® SPSS® Statistics, STATA, and other statistical software. SAGE publications, 2010.
15. Bochi VC, Weber J, Ribeiro CP, Victório ADM, Emanuelli T. Fishburgers with silver catfish (Rhamdia quelen) filleting residue. Bioresource Technology,2008:99(18):8844-8849.
16. Lee JS. Commercial Catfish Farming, 337, Interstate Publishers, Danville, IL, 1991.
17. Dreeling N, Allen P, Butler F. Effect of cooking method on sensory and instrumental texture attributes of low-fat beefburgers. LWT-Food Science and Technology,2000:33(3):234-238.
18. Kucukgulmez A, Celik M, Yanar Y, Ersoy B, Cikrikci M et al. Effects of different cooking methods on the proximate composition and mineral contents of sea bass (Dicentrarchus labrax). Advances in food sciences,2006:28(4):223-227.
19. Raj AJA, Haniffa MA, Seetharaman S, Appelbaum S. Utilization of various dietary carbohydrate levels by the freshwater catfish Mystus montanus (Jerdon). Turkish Journal of fisheries and aquatic sciences,2008:8(1):31-35.
20. Asmah R, Sumaiyah SS, Nurul SR. Comparison of protein, total fat, and omega-3 fatty acids content in yellowtail catfish (Pangasius pangasius) and long tail shad (Hilsa (clupea) macrura) in raw and pressurized fish. International Food Research Journal,2014a:21(6):2147.
21. Nurhan U. Change in proximate, amino acid and fatty acid contents in muscle tissue of rainbow trout (Oncorhynchus mykiss) after cooking. International journal of food science & technology,2007a:42(9):1087-1093.
22. Nurhan U. Change in proximate, amino acid and fatty acid contents in muscle tissue of rainbow trout (Oncorhynchus mykiss) after cooking. International journal of food science & technology,2007b:42(9):1087-1093.
23. Weber J, Bochi VC, Ribeiro CP, Victório ADM, Emanuelli T. Effect of different cooking methods on the oxidation, proximate and fatty acid composition of silver catfish (Rhamdia quelen) fillets. Food Chemistry,2008a:106(1):140-146.
24. Larsen D, Quek SY, Eyres L. Effect of cooking method on the fatty acid profile of New Zealand King Salmon (Oncorhynchus tshawytscha). Food Chemistry,2010:119(2):785-790.
25. Koubaa A, Mihoubi NB, Abdelmouleh A, Bouain A. Comparison of the effects of four cooking methods on fatty acid profiles and nutritional composition of red mullet (Mullus barbatus) muscle. Food Science and Biotechnology,2012:21(5):1243-1250.
26. Şengor GFU, Alakavuk DU, Tosun ŞY. Effect of cooking methods on proximate composition, fatty acid composition, and cholesterol content of Atlantic Salmon (Salmo salar). Journal of aquatic food product technology,2013:22(2):160-167.
27. Neff MR, Bhavsar SP, Braekevelt E, Arts MT. Effects of different cooking methods on fatty acid profiles in four freshwater fishes from the Laurentian Great Lakes region. Food chemistry,2014:164:544-550.
28. Asmah R, Sumaiyah SS, Nurul SR. Comparison of protein, total fat, and omega-3 fatty acids content in yellowtail catfish (Pangasius pangasius) and long tail shad (Hilsa (clupea) macrura) in raw and pressurized fish. International Food Research Journal,2014b:21(6):2147.
29. Ezhil C. Superheated steam drying of foods—A review. World journal of dairy and food sciences,2010:5(2):214-217.
30. Idrus NFM, Yang TA. Comparison between roasting by superheated steam and by convection on changes in colour, texture and microstructure of peanut (Arachis hypogaea). Food Science and Technology Research,2012:18(4):515-524.