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FATTY ACID PROFILE OF FISH AND LINSEED OILS UTILIZED IN JAPANESE QUAIL RATION

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Abstract: The samples of n-3 PUFA rich sources such as fish and linseed oils used in a series of biological studies were received from reputed manufacturers and subjected to lipid extraction using transmethylation process and the fatty acids composition of fish and linseed oils were analyzed by gas chromatography technique. The results of this study revealed that the fish oil contained the higher amount of EPA (15.60 per cent) and DHA (9.00 per cent) while linseed oil contained the lower amount of EPA (1.20 per cent) and DHA (0.06 per cent). On the other hand, the linolenic acid content of fish and linseed oils were 1.50 per cent and 53.60 per cent, respectively. The statistical analysis revealed highly significant ($P<0.01$) difference in linolenic acid content of oils studied in this study.
Keywords: Fish oil-Linseed oil-Fatty acids composition-Japanese quail ration.

INTRODUCTION

The fundamental studies have shown specific and beneficial effects on human health and well-being through consumption of long chain n-3 polyunsaturated fatty acids (PUFAs), in particular Eicosapentaenoic acid (EPA), Docosahexaenoic acid (DHA) and Alpha-Linolenic acid. Recent research revealed that the fatty acid composition of lipids of avian egg yolk and muscle tissues can be modified to match human nutritional guidelines better by appropriately manipulating the fatty acid composition of the diet (Leskanich and Noble, 1997). Omega-3 fatty acids pose interesting challenges to the food industries to convert recent knowledge into a means of producing healthier foods. In order to enrich Japanese quail egg and meat by supplementing n-3 lipid sources independently and simultaneously in Japanese quail ration, an attempt has been made to assess fatty acid composition in fish oil and linseed oil.

MATERIALS AND METHODS

The samples of n-3 PUFA rich sources such as fish and linseed oils used in the biological study were received from reputed manufacturers and analyzed for their fatty acid composition by Gas Chromatography method.

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Samples of fish and linseed oils were subjected to extract lipids and transmethylation process as described by Folch *et al.* (1957) and Sukhija and Palmquist (1988).

RESULTS AND DISCUSSION

FATTY ACIDS COMPOSITION OF FISH AND LINSEED OILS

The mean fatty acids composition of fish and linseed oils utilized in this study is presented in Table 1.

Myristic acid

The results of this study indicated that fish oil had the higher myristic acid value (1.20 per cent) when compared to linseed (0.02 per cent) oil and the statistical analysis revealed highly significant ($P<0.01$) difference on myristic acid value among the n-3 PUFA rich oil sources.

Palmitic acid

The results revealed highly significant ($P<0.01$) difference due to different n-3 PUFA rich lipid sources on palmitic acid content of fish oil which had the higher palmitic acid content (13.60 per cent) as compared to linseed (7.10 per cent) oils. This is supported by Sargent and Henderson (1995) who found that the palmitic acid content of fish oil derived from different varieties of fish ranged from 130 to 170 g per kg total fatty acids, which is almost similar to the value obtained in the present study. Meanwhile, Mehta *et al*. (2000) reported that the palmitic acid content of linseed oil ranged from 5.4 to 7.7 per cent, respectively, which is in accordance with the results obtained in this study.

Stearic acid

Fish oil used as n-3 PUFA rich lipid source had the higher value of stearic acid content (2.30 per cent) when compared to linseed (1.80 per cent) oil. The statistical analysis indicated highly significant ($P<0.01$) difference on stearic acid content due to these oils. The difference due to oil was found to be highly significant ($P<0.01$). Lands (1986), Sargent and Henderson (1995) and Sargent (1997) observed that stearic acid content of fish oil derived from different varieties of fish ranged from 10 to 40 g per kg total fatty acids, which is almost agreeable with the results of this study. However, Mehta *et al.* (2000) indicated that the stearic acid content of linseed oil ranged from 3.80 to 9.20 which are higher than the results obtained in this study.

Oleic acid

Among the n-3 lipid sources used in this study, the linseed oil had higher value of oleic acid content (26.90 per cent), while the fish oil recorded the lower value of 18.40 per cent. The

statistical analysis revealed highly significant (P<0.01) difference due to oils on oleic acid content. According to Mehta *et al.* (2000), the oleic acid content of linseed oil ranged from 20.0 to 28.5 per cent respectively, which is similar to the results obtained in this study. However, Lands (1986), Sargent and Henderson (1995) and Sargent (1997) reported that the oleic acid content of fish oil derived from the various types of fish ranged from 100 to 190 g per kg total fatty acids which is in agreement with the results of this study.

Linoleic acid

The study revealed that the fish oil recorded the higher value (4.9 per cent) of linoleic acid when compared to linseed (2.80 per cent) oils. On statistical analysis, the linoleic acid content showed highly significant (P<0.01) difference due to oils. Mehta *et al.* (2000) reported that the linoleic acid content of linseed oil ranged from 8.1 to 15.8 per cent which is not in agreement with the results of this study. However, Lands (1986), Sargent and Henderson (1995) and Sargent (1997) observed that the linoleic acid content of fish oil derived from various types of fish ranged from 10 to 38 g per kg total fatty acids which is higher than the results obtained in this study.

Linolenic acid

In this study, the linolenic acid content of fish and linseed oils were 1.50 per cent and 53.60 per cent, respectively. The mean linolenic acid content of linseed oil was maximum, while the fish oil contained the minimum amount of linolenic acid. The statistical analysis revealed highly significant (P<0.01) difference on linolenic acid content due to oils used in this study. Lands (1986) and Sargent (1997) reported that the linolenic acid content of fish oil derived from different varieties of fish ranged from 6.02 to 20.0 g per kg total fatty acids which is higher than the value obtained in the present study. However, Mehta *et al.* (2000) reported that the linolenic acid content of linseed oil ranged from 47.0 to 57.0 per cent which coincides with the value obtained in this study.

Eicosapentaenoic acid (EPA)

The results of this study showed that the fish oil contained the higher amount of EPA (15.60 per cent), while linseed oil contained the lower amount of EPA (1.20 per cent). The statistical analysis revealed highly significant (P<0.01) difference due to oils with respect to EPA content of n-3 PUFA rich sources utilized in this study. Sargent and Henderson (1995) and Sargent (1997) reported that the EPA content of fish oil derived from different varieties of fish ranged from 60 to 170 g per kg total fatty acids. The EPA content of fish oil utilized in this study is well within the range as reported by the above authors.

Docosahexaenoic acid (DHA)

Higher amount of DHA (9.00 per cent) was recorded in fish oil as compared with linseed (0.06 per cent) oil and the statistical analysis indicated highly significant (P<0.01) difference due to oils with respect to DHA content of n-3 PUFA rich lipid sources. The statistical analysis indicated highly significant (P<0.01) difference due to oils. Sargent and Henderson (1995) and Sargent (1997) observed that the DHA content of fish oil derived from various types of fish ranged from 40 to 151 g per kg total fatty acids which is in agreement with the results obtained in this study.

Total n -3 fatty acids

The study revealed that the total n-3 PUFA content in fish and linseed oils were 26.10 and 54.80 per cent respectively. The mean total n-3 fatty acids content of linseed oil was maximum and the statistical analysis revealed highly significant (P<0.01) difference due to oils on total n -3 PUFAs content. Lands (1986) observed that the n-3 PUFAs in fish oil obtained from the various types of fish ranged from 148.0 to 284.0 g per kg total fatty acids. The total n-3 PUFAs obtained from fish oil utilized in this present study is well within the range as reported by the above authors.

Total n-6 fatty acids

From the table, it was inferred that the total n-6 fatty acids content in fish and linseed oils were 4.90 and 2.80 per cent. The fish oil recorded higher content of mean total n-6 PUFAs content as compared to linseed oil and the statistical analysis showed highly significant (P<0.01) difference due to n-3 PUFA rich oil sources on total n-6 fatty acids content.

SUMMARY

The results of this study revealed that the fish oil contained the higher amount of EPA (15.60 per cent), DHA (9.00 per cent) while linseed oil contained the lower amount of EPA (1.20 per cent) and DHA (0.06 per cent). On the other hand, the linolenic acid content of fish and linseed oils were 1.50 per cent and 53.60 per cent, respectively. The mean linolenic acid content of linseed oil was maximum, while the fish oil contained the minimum amount of linolenic acid. The statistical analysis revealed highly significant (P<0.01) difference on linolenic acid content due to oils used in this study.

TABLE-1
MEAN (± S.E.) FATTY ACIDS COMPOSITION (%) OF POLYUNSATURATED FATTY ACID (PUFA) RICH FISH AND LINSEED OILS

PUFA rich sources	Myristic acid	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid	EPA	DHA	Total n-3 Fatty acids	Total n-6 Fatty acids
Fish oil	**01.20^{B} ±0.36**	**13.60^{B} ±1.29**	**02.30^{B} ±0.18**	**18.40^{A}± 0.91**	**04.90^{B} ±0.35**	**01.50^{A} ±0.10**	**15.60^{B} ±0.55**	**09.00^{B} ±0.87**	**26.10^{B} ±1.27**	**04.90^{B} ±0.35**
Linseed oil	**00.02^{A} ±0.02**	**07.10^{A} ±0.33**	**01.80^{A} ±0.31**	**26.90^{B} ±1.19**	**02.80^{A} ±0.42**	**53.60^{B} ±0.38**	**01.20^{A} ±0.02**	**00.06^{A} ±0.01**	**54.80^{A} ±0.37**	**02.80^{A} ±0.42**

The value in each cell is the mean of six observations

$^{A-B}$Mean values not sharing a common superscript columnwise differ significantly ($P<0.01$).

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