Food Science and Quality Management
ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online)
Vol.35, 2015

Effects of Salt, Detergents and Alum on Fatty Acid Profile in Cooked Eggs

*Ibiam, U. A[1] Ezeani, N[1] Igwenyi, I. O[1] Orji, O. U., Edeogu, C. O.[2] Uraku, A. J[1].
Ugwu Okechukwu P.C[1].
1.Department of Biochemistry, Faculty of Biological Sciences, Ebonyi State University, Abakaliki
2.Department of Medical Biochemistry, Faculty of Basic Medical Sciences, Ebonyi State University, Abakaliki
*Corresponding Authors Email Address: telludu@yahoo.co.uk

Abstract
In Abakaliki, as in most other parts of Nigeria, it is a common practice among commercial sellers of boiled eggs to boil them with chemicals such as omo, klin, table salt and alum, which gives the egg ashy appearance after cooking. The effects of cooking with these chemicals on the fatty acid profile of eggs from four species of birds (gallus gallus): Quail (corturnix delegorgei), Guinea fowl (Numida meleagris), local chicken (Gallus varius) and high-breed chicken (Gallus gallus domesticus) were investigated. Fifteen eggs from each bird were bought from various places where they were reared in Abakaliki. Eggs were divided into five groups: A, B, C, D and E, with three eggs in each group. Eggs in groups A, B, C, and D were boiled with omo, klin, table salt and alum, respectively. Group E eggs served as the control group and were boiled with water only. Fatty acid profile was determined using High Performance Liquid Chromatography (HPLC, AKAPTA). The results showed significant ($P<0.05$) reduction of fatty acids contents of the eggs compared to the control. The effects which were species-dependent were found to be least in the quail egg and highest in the high-bred chicken. The detergents (klin and omo) had more devastating effects compared to alum and table salt. Thus boiling eggs with any of the chemicals studied reduced their nutritional quality and should be discouraged.
Keywords: Egg, fatty acid profile, detergents, salt and alum

1.0 Introduction

Eggs are a nutritionally rich food, which are high in protein and contain a wide variety of vitamins and minerals (Combs and Gerald,.2008; Rebecca, 1988). Eggs also contain fat, but merely a trace of carbohydrate, and no fibre. Even though eggs are high in cholesterol, they are low in saturated fat but high in monounsaturated fats, and the saturated fatty acid component of the fat is low (Dawber et al., 1982; Kritchevsky and Kritchevsky 2000). Therefore, eggs are well recommended as supplements in human nutrition (.Stipanuk. and Martha, 2006). They complement other food proteins of lower biological value by providing the amino acids that are in short supply in those foods (Ensminger and Esminger, 1986; Roux, *et al* 2006, Stadelman *et al*., 1995). The precise amounts the nutrients found in eggs vary depending on the breed of laying bird, the diet, and the conditions under which they were reared.

Most edible eggs include eggs from birds (gallus gallus): quail (*corturnix delegorgei*), guinea fowl (*Numida meleagris*), local chicken (*Gallus varius*) and high-breed chicken (*Gallus gallus domesticus*), to mention a few (Aurand, *et* al., 1987; Hoyo et al., 1999)).

It is an established fact that some important nutrients in foods are lost during processing. This is more evident where foods are cooked with some chemical additives (McGee *et al*., 2004; McGuire et al,, 2007**)**. In Abakalili metropolis, as in many other parts of Nigeria, eggs are cooked with various chemicals such as sodium chloride (table salt), alum and detergents. This is a common practice by those who cook eggs for sale, for instances, at the motor parks, along the streets and in schools. Their reason for cooking with alum (aluminium potassium sulphate) or detergents is to preserve the integrity of the egg shell and prevent cracking during cooking and hence reduce financial loss due to cracking of the shell.

Alum, is a term given to the crystallized double sulphate of the typical formula $M_2SO_4 \cdot MIII_2(SO_4)^3 \cdot 24H_2O$, where M stands for an alkali metal lithium, sodium, potassium, rubidium, caesium, and MIII denotes one of the trivalent metals aluminium, chromium or iron (Darbre, 2006). These salts are employed in dyeing and various other industrial processes. They are soluble in water and have an astringent acid and sweetish taste (Greenwood et al., 1997)

Omo and klin are brand names of detergents. A detergent is a material which has cleaning properties and it is sometimes used to differentiate between soap and other surfactants used for cleaning (Outwater, 1996).Omo detergent is mostly produced from palm kernel oil which is less effective than Klin produced from petroleum and the solubility of Klin in water is higher than Omo. The brand names differentiate them (Spriggs et al ., 2008). They have wetting, emulsifying and dispersing properties, enabling the removal of dirt (soil) from fabrics and keeping the soil suspended in the washing water. Laundry detergents are formulated from six groups of substances such as Surfactants, builders, bleaching-agents, enzymes, fillers and other minor additives (Outwater, 1996). They also contain EDTA, which is a synthetic water softener and performs the same function as phosphates. They help to tie up mineral ions such as Mg^{++} and Ca^{++} in solution, making it possible for the surfactants to be free to do their work of removing dirt (Outwater, 1996). Table salt is a food additive used in cooking. Chemically it contains sodium and chlorine

Eggs cooked with these chemicals are bought and consumed by the unassuming public with the hope that they are eating whole egg with all the nutrients compositions intact. To the best of our knowledge, there is yet no scientific data on the possible effects of these additives on the nutritional composition of eggs. This is the main focus of this research.

2.1 Materials and Methods

2.1.1 Sample Collection and distribution

Guinea fowl and Quail eggs were sourced from Fidgimor Poultry Farm, Abakaliki. High-breed chicken egg samples were sourced from Ebonyi State Poultry Farm, Nkaliki, Abakaliki, while native chicken eggs were sourced from a neighbour . A total of sixty eggs were used and consisted of fifteen eggs from each bird. Eggs from each bird species were divided into five groups: A, B, C, D and E, with three eggs in each group. Eggs in groups A, B, C, and D were boiled with omo, klin, table salt and alum, respectively. Group E eggs served as the control group

2.1.2 Sample preparation.

All the eggs were properly washed with tap water to remove debris and dirt. The cooking time for the eggs was standardized at 12 minutes. Cooked eggs were peeled to remove the shell. The egg yolk and albumin were grounded in a mortar using a pestle. The ground sample was immediately used for the various analyses.

2.1.3 Determination of Fatty Acid Profile

Fatty acids (linoleic acid, oleic, palmitic, mystric and stearic acid) were determined using HPLC method as described by Nikolova-Damyanova, (1997). All chemicals used were of analytical grade and HPLC grade and they were purchased from BDH, except where otherwise stated.

3.1 STATISTICAL ANALYSIS.

Data were expressed as mean±SD and analyzed statistically using One Way Analysis of Variance (ANOVA). The minimum level of significance was expressed at $P<0.05$.

4.1 Results

The results are presented in Figures 1-5. Our results showed that the effects of the chemicals on the fatty acids were species dependent. All the fatty acids were adversely affected by the treatments, though however, in some cases, the effects were not significant ($P<0.05$). For instance, in quail egg (*Corturnix delegorgei*), alum had no significant ($P<0.05$) effects on myristic acid and stearic acid, whereas it had significant ($P<0.05$) effects on the other three fatty acids (palmitic,

oleic and linoleic acids). Detergents and table salt significantly ($P<0.05$) reduced the concentration of all the fatty acids (Figure 1). The detergents had more devastating effects on the fatty acids compared to either alum or table salt. Among the species of eggs tested, the effect was least on the fatty acids of quail eggs.

In the *Gallus varius* (native chicken) egg (Figure 2), the concentrations of linoliec, oleic, myristic and stearic acids were significantly ($p<0.05$) reduced by table salt and klin detergent. Omo significantly ($p<0.05$) reduced strearic acid concentration. Table salt and klin detergent had more devastating effects on the fatty acids of the eggs when compared to other chemicals

In the *Gallus gallus domesticus* (high breed chicken) egg (Figure 3), linoleic acid, and oleic acids were significantly ($p<0.05$) reduced by omo and klin detergents, while palmitic, and myristic were significantly reduced by all the chemicals. Stearic acid was reduced by all the chemicals except alum. The detergents had more destructive effects on the fatty acids than table salt and alum. Similarly, in *Numida meleagris* (Guinea fowl) egg (Figure 4), the concentration of linoleic acid was significantly ($p<0.05$) reduced by salt; oleic, palmitic and myristic acids by klin while Stearic acid was reduced by omo detergent.

Comparing the fatty acid contents of the eggs, generally, the fatty acids varied among the different egg species (Figure 5). Oleic acid was highest in guinea fowl (*Numida meleagris*) egg, and lowest in native fowl *(Gallus varius)* egg; linoleic acid was most abundant in quail egg (*Corturnix delegorgei*), and lowest in native chicken. Similarly, palmitic acid was highest in guinea fowl (*Numida meleagris*) and least in native fowl *(Gallus varius)*; while myristic acid was most abundant *Gallus varius* (native chicken) egg, it was lowest in quail (*Corturnix delegorgei*) egg. Stearic acid was most abundant in high-bred chicken (*Gallus gallus domesticus)* and lowest in guinea fowl egg (*Numida meleagris*). Our results are in consonant with some findings of Roux *et at* (2006).

5.1 Discussion

Presently, the reasons for the above results are not yet clearly understood. However, some explanations may be offered here based on the nature of the egg shell, the components of the chemicals used and the fatty acid itself.

The porous nature of the egg shell may have allowed some of the chemicals (table salt, alum, and detergents) to sip into the interior of the egg during cooking (Hoyo *et al*..1999) and interact with components of the egg, which includes the fatty acids. For instance, the carboxy group (-COOH) of the fatty acids is easily attacked by Na^+ (from the salt or alum), K^+ and Al^{3+} (from the alum), and EDTA (from the detergents). This displacement reaction may lead to the formation entirely new products resulting in the reduction of the amount of fatty acids itself detectable by the instrument used for the analysis. In addition, the presence of K^+ or Na^+ in alum can displace the H or OH to give an entirely new product with a high molecular weight. All these will result in reduction of the amount of fatty acids in the samples and consequently reduce the nutrient value of the eggs.

Generally, the effect of the chemicals on the fatty acid contents of guinea fowl egg was far less than found in the other eggs. This could be attributed to the thickness of its egg shell.. The thick and hard shell may not have allowed much of the chemicals to sip into the eggs thereby reducing the effects on the nutrient components of the egg.

In conclusion, our results have demonstrated that these eggs studied here are very rich in biologically essential fatty acids; but cooking them with detergents, salt or alum, as is currently being practised in many towns in Nigeria, destroys these physiologically important biommolecues and hence reduce the nutritional quality of the eggs. We advocate that these practices should be discouraged by the relevant agencies in Nigeria.

References

Aurand, L.W., Woods, A.E. and Wells, M.R. (1987). Food Composition and Analysis. Journal of clinical nutrition,. 1189

Combs, M. and Gerald, F. (2008). The Vitamins. Fundamental Aspects in Nutrition and Health (3rd ed.). Burlington: Elsevier Academic Press. pp 123-134.

Davis, B.C., Kris- Etherton P.M. (2003). Achieving Optimal essential Fatty acids status in vegetarians: current Knowledge and practical implications. American Journal of clinical Nutrition. xxxx

Ensminger, A.H. and Esminger, M. K. (1986). Food for Health: A Nutrition Encyclopedia. Clovis, California: Pegus Press; Pp 213- 235

Hoyo, J., Elliott, A. and Sargatal, J.(1999) Handbook of the Birds of the World: New world
Vultures to Guinea fowl. Vol. 2. Lynx Edicions, Barcelona. pp 6-35**.e**

Kritchevsky, S.B. and Kritchevsky, D. (2000) Egg consumption and coronary heart disease: an epidemiological overview. American Journal of Nutrition*, 19:549S-555S.*

McGee, N, and Harold, F. (2004). On Food and Cooking: The Science and Lore of the Kitchen. Scribner, p. 117.

McGuire, Michelle; Beerman, Kathy A. (2007). Fundamentals *to food. Journal of Nutritional science,19:123.*

Nikolova-Damyanova, B. (1997). Reversed-phase high- Performance liquid chromatography: general principles and application to the analysis of fatty acids In: *Journal of Advances in Lipid Methodolog*, 4: 193-251

Rebecca, W. (1988). The Whole Foods Encyclopedia. New York: Prentice-Hall Press.PP86-97

Roux, M. and Martin, B (2006). Eggs. 2nd ed. Wiley press, New York. p. 8.

Stadelman, L. and William, J. (1995). Egg Science and Technology. Haworth Press, New York City. pp.221-480.

Stipanuk, G. and Martha,H. (2006). Biochemical, Physiological and Molecular Aspects of Human Nutrition 2nd ed. Philadelphia: Saunders .pp 129-160.

Shahidi, Fereidoon; John Shi; Ho, Chi-Tang (2005). Asian functional foods. Boca Raton: CRC Press. pp. 575Aurad et al 1987

Dawber, T. R., Nickerson, R.J., Brand F.N. and Pool, J. (1982). Eggs, serum cholesterol and coronary heart disease. American Journal of Clinical Nutrition

Greenwood, N. N., and Earnshaw, A. (1997). Chemistry of the Elements (2nd Edn.), Oxford Butterworth, Heinemann

List of Figures

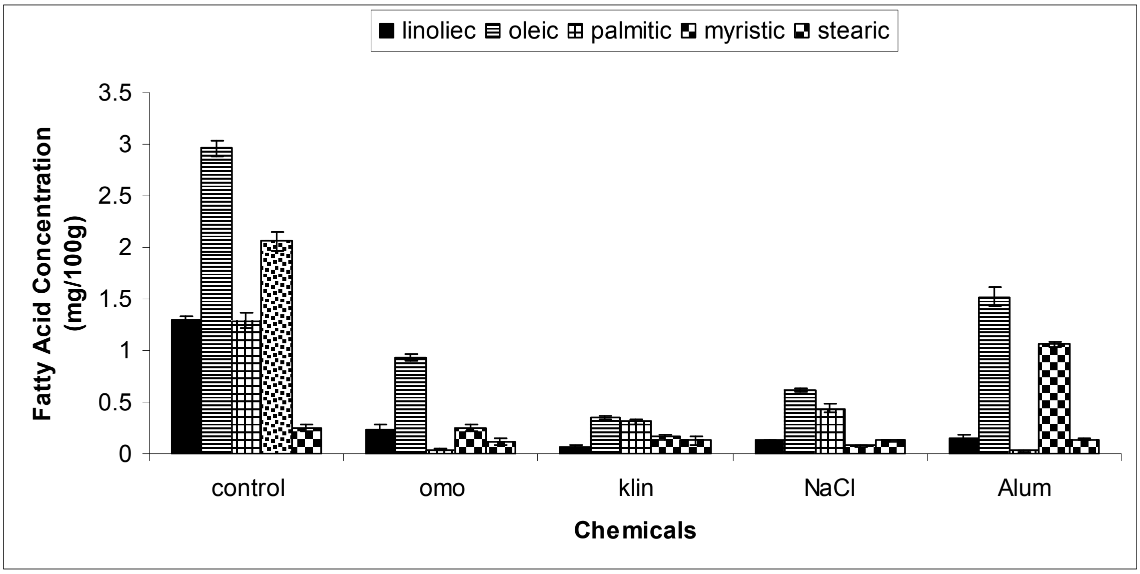

Figure 1: Effects of omo, klin, table salt and alum on fatty acid profile of cooked eggs of quail (Cortunix delegorgei). There was significant (P<0.05) reduction of fatty acids by the chemical, specially the detergents and table salt.

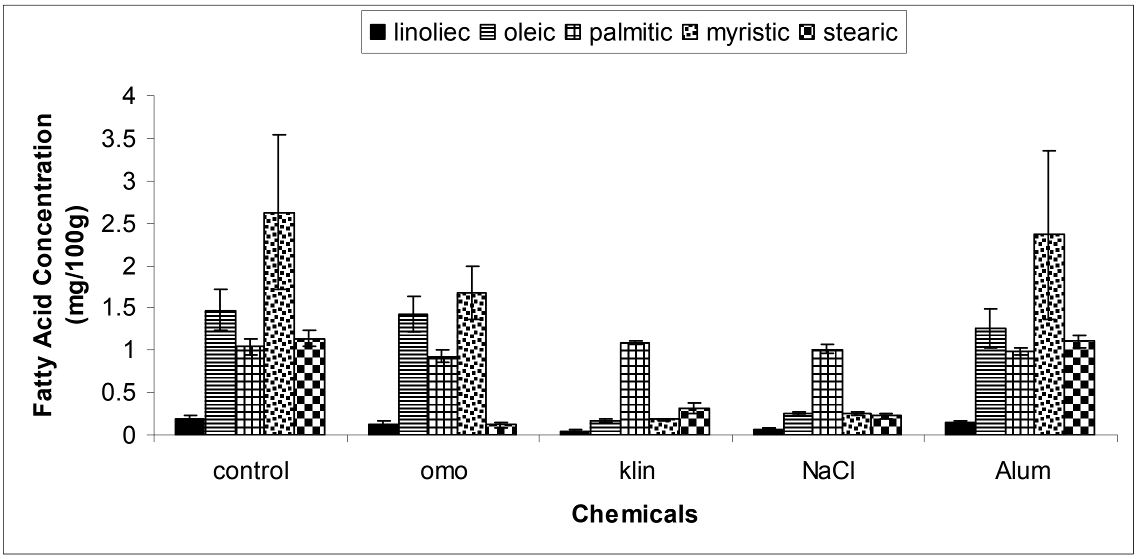

Figure 2: Effects of omo, klin, table salt and alum on fatty acid profile of cooked eggs of native chicken (Gallus varius). There was significant (P<0.05) reduction of fatty acids by the chemical, specially klin detergents and table salt

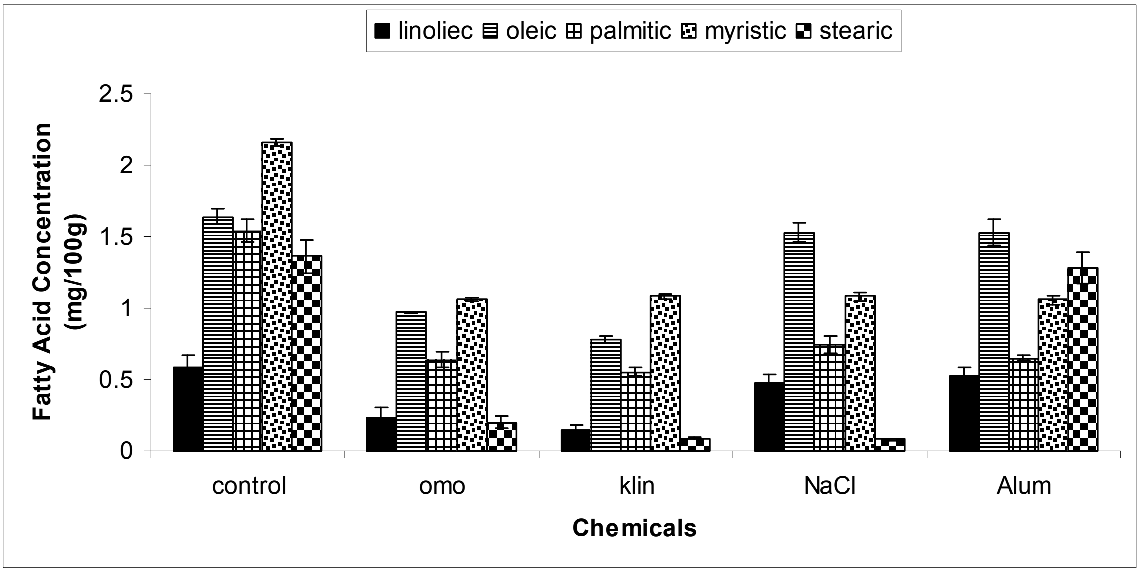

Figure 3: Effects of omo, klin, table salt and alum on fatty acid profile of cooked eggs of high-bred chicken (*Gallus gallus domesticus*). There was significant (P<0.05) reduction of fatty acids by the chemical, specially the detergents.

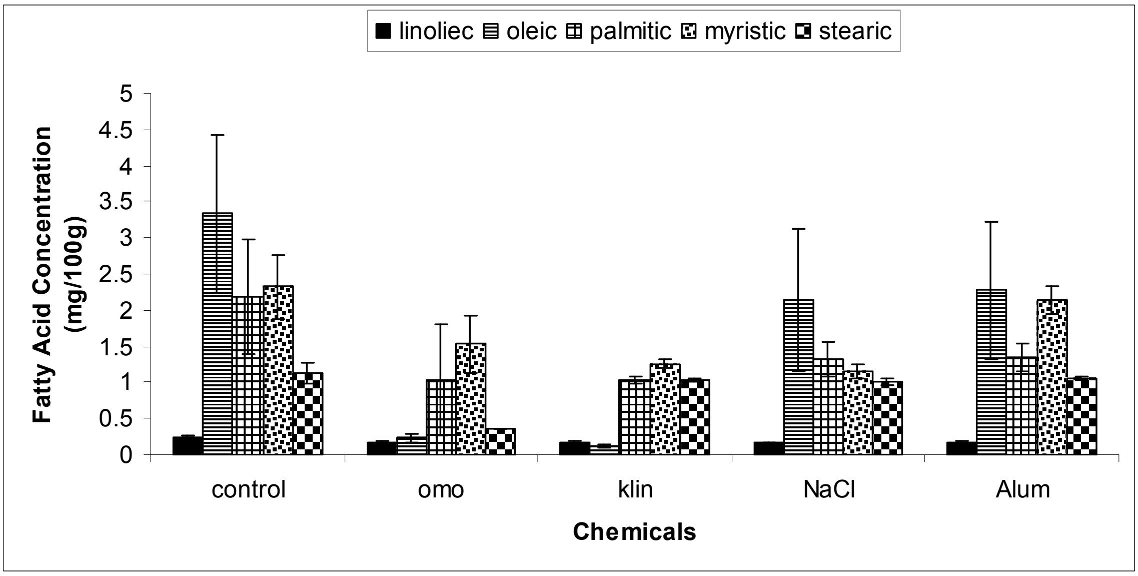

Figure 4: Effects of omo, klin, table salt and alum on fatty acid profile in cooked eggs of Guinea fowl (*Numida meleagris*). There was significant (P<0.05) reduction of fatty acids by the chemical, specially the detergents.

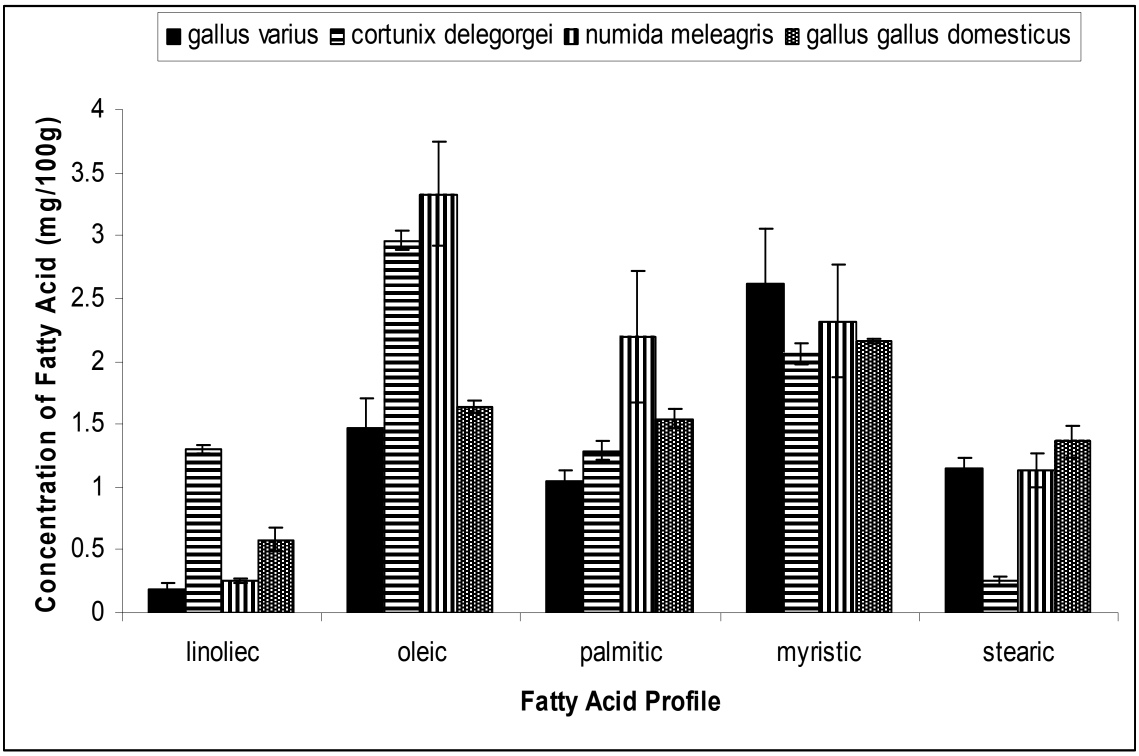

Figure 5: Comparison of the fatty acid levels in eggs of different bird species
This shows varied concentration of fatty acids in eggs of different bird species.