**Evaluation of Omega-3, Omega-6 and Lipid Contents of Wistar Rats Treated with Frequently Used Cooking Oil in Nigeria**

**ABSTRACT**

Many studies suggest a connection between the consumption of vegetable oils and cardiovascular diseases (CVD). This research investigated the effects of various cooking oils on the lipid profiles of Wistar rats. The study involved forty-two Wistar rats, approximately 3 months old, with an average weight of 140 ± 2.45 g. The oils examined included palm oil, Emperor oil, Golden Penny oil, Mamador oil, King's oil, and Power oil, sourced from different Port Harcourt, Nigeria markets. Each rat in the respective oil group received 1.0 ml of their assigned oil orally for 30 days, while the control group received no oil. On the 31st day, after a night of fasting, the rats were anaesthetised, and blood samples were collected via cardiac puncture into labelled plain bottles. These samples underwent lipid profile analysis using enzymatic methods and GC-MS, which identified components of omega- 3 and omega- 6 fatty acids. Examining various cooking oil brands uncovered several essential fatty acids, including EPA, DHA, and DPA. The findings indicated a significant increase in overall cholesterol levels (p < 0.05) in all groups except the palm oil group (1.20 ± 0.11 mmol/l), which was similar to the control group (1.26 ± 0.24 mmol/l). HDL- C levels were notably higher in groups consuming Golden Penny oil (1. 48 ± 0. 17 mmol/l), King's oil (1. 90 ± 0. 31 mmol/l), Mamador oil (1. 66 ± 0. 34 mmol/l), and Power oil (1. 29 ± 0. 69 mmol/l) compared to the control group (0. 70 ± 0. 23 mmol/l). Additionally, LDL-C levels significantly decreased in the King's oil group (0.15 ± 0.14 mmol/l) but increased dramatically in the Power oil group (0.86 ± 0.77 mmol/l) compared to the control group (0.27 ± 0.15 mmol/l). Triglyceride levels decreased significantly in the Emperor and Golden Penny oil groups, yet increased in the Power oil group (1.19 ± 0.72 mmol/l) compared to the control group (0.59 ± 0.15 mmol/l). In conclusion, the impact of different cooking oils on lipid levels in Wistar rats varies by brand, with palm oil displaying lower total cholesterol levels than the others. Palm, Golden Penny, and Emperor oils are particularly high in omega- 3, while Emperor and Golden Penny oils are abundant in omega- 6. Cooking oils containing omega- 3 and omega- 6 and lower total cholesterol levels may offer cardiovascular protection.

**Keywords: Lipids, Omega-3, Omega-6, cardiovascular risks and cooking oils**

**Introduction**

Cooking oils are crucial in today’s diet, acting as an energy source and offering various essential micronutrients (Tian et al., 2023). However, the relationship between cooking oil and cardiovascular disease risk has intrigued researchers for decades. Additionally, concerns surrounding the choice of new and popular cooking oil brands continue to exist (Voon *et al*., 2024).

Opinions differ on rejecting fats; however, certain edible oils are rich in Omega-3 and Omega-6, essential fatty acids that the body cannot produce. Consequently, Omega fatty acid dietary supplements may significantly enhance cardiovascular health and help manage other inflammatory conditions, especially since cardiovascular disease (CVD) is among the leading global causes of death (Voon *et al*., 2024). Trans fats, called trans-fatty acids, exist in natural and artificial forms (WHO, 2024). Natural trans fats, or ruminant trans fats, like conjugated linoleic acid (CLA), are present in meat and dairy from ruminant animals. Fortunately, those who consume dairy and meat need not be concerned, as various reviews have found that moderate fat consumption is not harmful (Lordan *et al.,* 2018; Geiker *et al.,* 2021).

However, artificial trans fats—industrial trans fatty acids (iTFAs) or partially hydrogenated fats—pose a health risk. These fats are produced when vegetable oils are chemically altered to remain solid at room temperature, significantly prolonging their shelf life. (Iqbal 2014).

Research has demonstrated that inflammation, atherosclerosis, and coronary heart disease (CHD) are exacerbated when trans-fats, saturated fatty acids, and cholesterol disrupt essential fatty acid (EFA) metabolism, including omega-3 (Sokoła-Wysoczańska *et al.,* 2018). This emphasises the pro-inflammatory role of trans-fats, saturated fats, and cholesterol, while EFAS and polyunsaturated fatty acids (PUFAS) exhibit anti-inflammatory properties. (Sokoła-Wysoczańska *et al*., 2018)

Consuming trans fats in oils generates free radicals that may harm the cardiovascular system. These free radicals accumulate total cholesterol (TC) and triglycerides (TG), leading to increased blood pressure, endothelial dysfunction, and vascular inflammation. Ultimately, this culminates in the formation of atherosclerotic plaque in the arteries (Kumar *et al.*, 2018).

Relatedly, evidence suggests that choosing a balanced diet can mitigate the risk of stroke, supporting the notion that life-threatening conditions related to cardiovascular diseases may be directly influenced by diet (Altobelli *et al*., 2019; Lin, 2021). However, cooking oils remain an integral part of a balanced diet, as their exclusion could lead to other potentially life-shortening disorders, such as diabetes mellitus, metabolic syndrome X, schizophrenia, depression, CHD, atherosclerosis, psoriasis, Alzheimer's disease, glomerulonephritis, cancer, and hypertension. (Jayadevan, 2017).

Furthermore, the diseases mentioned result from decreased fat intake and a shortage of fat-soluble vitamins (Christine *et al.,* 2014) and essential fatty acids typically found in oils and fats (Christine *et al*., 2014). Although previous studies have demonstrated that fatty acids and combinations of fatty acids benefit cardiovascular health (Bowen *et al.,* 2016), there is a need for a better understanding of the pathophysiology of atherosclerosis, mechanisms of lipid metabolism, and the associated risk factors for CVDs. Research has implicated atherosclerosis as a causative factor of death and morbidity in the industrial world (Mozaffarian *et al.,* 2015). Despite the health and nutritional value of cooking oil to humans, cooking oils are significant contributors to cardiovascular diseases (CVDS). Cooking oil contains fatty acids from both plant and animal sources. It can produce free radicals, increase cholesterol levels, and contribute to inflammatory processes and atherosclerosis, leading to the pathogenesis of various cardiovascular diseases (CVDS). Therefore, there is a need to investigate the levels of beneficial fatty acids, particularly omega-3 and omega-6, present in popular cooking oils while highlighting the possible unintended effects of new and emerging cooking oils available on the market, to mitigate the risks of cardiovascular disease (CVDS) in our society.

Economic factors significantly influence people's cooking oil consumption in developing countries like Nigeria. Consequently, new and affordable cooking oils often receive endorsements from various associations in Nigeria and are widely purchased and consumed without regard for potential health risks. It is essential to regularly monitor the truthfulness and accuracy of information on oil brand labels to ensure the products' efficacy remains unchanged.

**MATERIALS AND METHODS**

**2.1 Main Experimental Animals**

The experimental animals used in this study were male Wistar rats. Using the G. Power analytical tool, we selected forty-two (42) male Wistar rats with an average age and weight of twelve (12) weeks and 140 ± 2.45g. The rats were purchased from the Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, based on their physical alertness and activeness. The rats were placed in a secure cage. The housing for the Wistar rats comprised a conventional wire mesh metal cage with dimensions of 36 inches × 71 inches. The cage was divided into seven compartments of equal size. The compartments were aerated correctly, and the cage bedding consisted of pine shavings. The rats were placed in the cage compartments and kept under standard rat laboratory conditions (at room temperature 25 ºC, 40-50% humidity and proper ventilation). The rats were made to acclimate to the environment for two weeks. The rats were shielded from exposure to rainfall and high sunlight. The rats were given clean tap water for drinking and fed with pellet feeds for the entire experiment period.

**2.2 Animal Selection and Grouping**

A total of 42 Wistar rats were randomly divided into seven groups of 6 rats each, based on the type of oil administered:

Group 1 (Control): Fed standard rat feed and given clean drinking water.

Group 2 (Palm Oil): Fed standard rat feed, clean drinking water, and orally gavaged with 1.0 mL of Palm Oil daily.

Group 3 (Emperor Oil): Fed standard rat feed, clean drinking water, and orally gavaged with 1.0 mL of Emperor Oil daily.

Group 4 (Golden Penny Oil): Fed standard rat feed, clean drinking water, and orally gavaged with 1.0 mL of Golden Penny Oil daily.

Group 5 (King’s Oil): Fed standard rat feed, clean drinking water, and orally gavaged with 1.0 mL of King’s Oil daily.

Group 6 (Mamador Oil): Fed standard rat feed, clean drinking water, and orally gavaged with 1.0 mL of Mamador Oil daily.

Group 7 (Power Oil): Fed with standard rat feed, clean drinking water, and orally gavaged with 1.0 ml of Power Oil daily.

**2.3 Feeding and Oil Administration**

All groups received identical standard rat feed and clean drinking water ad libitum throughout the 30-day study period. The experiment was conducted for 30 consecutive days to ensure consistent exposure to the oils and allow for measurable physiological changes. This study adapted the methods of administering 1.5 ml and 2 ml of vegetable oil to Wistar rats, by Zhou *et al.* (2016) and Maduelosi *et al*. (2019).

2.4 **Sample Collection Procedure**

After the 30-day experimental period, six rats from each group were selected for analysis. Each rat was anaesthetised using chloroform (CHCl3) in a well-ventilated area to ensure minimal stress and humane handling. The anaesthetised rats were placed supine on a dissecting board with their limbs gently pinned to secure them in place.

A surgical blade was used to make a longitudinal incision along the abdominal midline and an additional incision on the upper left thorax to expose the heart. Using a sterile syringe, 5 ml of blood was drawn via cardiac puncture directly from the heart.

The collected blood was immediately transferred into pre-labelled plain bottles. The collected blood samples were centrifuged at 4,000 rpm to separate serum, which was then stored appropriately at 4°C until further biochemical analysis

**2.5 Laboratory Analysis**

**2.5.1. Determination of Total Cholesterol**

This was done using the enzyme method (Allain *et al*.*,* 1982). Cholesterol was determined after enzymatic hydrolysis and oxidation. The indicator quinone imine is formed from hydrogen peroxide and amino antipyrine in the presence of phenol and peroxidase.

**2.5.2 Determination of Triglyceride**

Triglyceride was determined by Enzymatic Method (Fossati, P., & Prencipe, L., 1982).Triglycerides are determined after enzymatic hydrolysis with lipases. The indicator is a quinoneimine formed from hydrogen peroxide, 4-aminophenazone, and 4-chlorophenol under the catalytic influence of peroxidase.

**2.5.3 Determination of HDL Cholesterol**

The Enzymatic Colourimetric Method (Assmann, 1979) was employed to determine the HDL-cholesterol. LDL, VLDL, and chylomicron fractions are quantitatively precipitated by adding phosphotungstic acid in the presence of magnesium ions. After centrifugation, the cholesterol in the HDL that remains in the supernatant is determined.

**2.5.4 Determination of Low-Density Lipoprotein- Cholesterol (**Friedewald *et al*, 1972**)**.

**Friedewald Equation**

LDL cholesterol = total cholesterol – triglyceride/2.2-HDL

**2.5.5 Determination of Serum Omega-3 and Omega-6**

GC-MS employs two techniques that are combined into a single method for analysing mixtures of chemicals. Gas chromatography separates the components of a mix, while mass spectroscopy characterises each element individually. Combining these techniques facilitates both qualitative and quantitative analysis of the samples. When the sample is injected into the chromatograph, the mixture is separated into individual components based on their different flow rates. This process enables a quantitative analysis of the components and a mass spectrum for each element. A specific spectral peak is generated for each component, which is recorded electronically on a paper chart.

**2.6 Statistical Analysis**

GraphPad Prism version 9.03 (San Diego, California, USA) was used to analyse the data generated. Analysis of variance (ANOVA) and post hoc multiple comparisons were employed to compare the measured parameters. Additionally, Pearson's correlation was used to determine the associations. Results are presented as Mean ± SD and considered significant at a 95% confidence interval (p≤ 0.05).

**3. Results**

**The results show the mean and standard deviation of the lipid profiles in Wistar rats administered different cooking oils.**

This study revealed that the total cholesterol (TC) levels in Wistar rats administered various oils have significant implications for nutrition and biochemistry. The cholesterol levels associated with each oil, particularly the notably high levels in the Power Oil group, highlight the Potential health implications of these commonly used cooking oils.

Post hoc analysis revealed significant differences (p < 0.05) in total cholesterol levels between the Control group and those administered Emperor Oil, Golden Penny Oil, King’s Oil, Mamador Oil, and Power Oil. No significant difference (p > 0.05) was observed in TC levels in the rats administered Palm Oil (Group 2): 1.20 ± 0.11 (mmol/L), compared to the negative control (Group 1). Among the groups, TC levels in the rats administered Power Oil (Group 7) showed the highest cholesterol levels, significantly higher (p < 0.05) compared to the other treatment groups. Comparisons between the rat groups indicated no significant difference (p > 0.05) between the Golden Penny and King’s Oil groups or between the Mamador Oil and Emperor Oil groups.

Post hoc comparisons showed no significant differences in HDL-C levels between the Palm Oil, Emperor Oil, and Control groups. However, HDL-C levels were significantly higher (p < 0.05)

In the Golden Penny Oil, King’s Oil, Mamador Oil, and Power Oil groups compared to the Control. Comparisons between rats in the groups show no significant difference (p > 0.05) in the HDL-C levels in the Golden Penny, King’s Oil, and Mamador Oil groups.

Post hoc analysis showed significant differences (P < 0.05) in LDL-C levels among groups. There was no significant difference (p > 0.05) in LDL-C between the palm oil, emperor oil, golden penny oil, mamador oil and the control groups. However, King oil was significantly lower (p < 0.05) than the control. More so, the LDL.C mean value in the power oil group was also significantly increased (p < 0.05) and differed from the control group.

ANOVA and Post hoc comparisons revealed significant differences (P < 0.05) in triglyceride levels between the groups and the control. Compared with the Control group, there was no significant difference (p > 0.05) in the Palm Oil, King’s Oil, and Mamador Oil rats. Triglyceride levels were significantly lower (p < 0.05) in the Emperor Oil and Golden Penny Oil groups compared to the Control. The rats in the Power Oil group had the highest triglyceride levels, significantly increased (p < 0.05), differing from the Control group (Table 1)

**3.1 Comparison of the Levels (Mean ± SD) of Omega-3 and Omega-6 (%per weight) in the different Groups treated with cooking Oils**

Table 1 displays the average Omega-3 and Omega-6 levels in the different groups of rats that were treated with various brands of cooking oils. Across all oil brands, there was a significantly higher average level (p<0.05) of Omega-3. The exception was King’s Oil, which had a statistically significantly lower level than the Control group at 7.86±3.95 (p<0.05). The mean levels of Omega-6 were lower, as shown in Table 2.

**Table 1: Results of Lipid Parameters in Groups of Wister Rats Orally Administered Different Cooking Oils Commonly Sold in Nigerian Markets**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameters | Control (Group 1) | Palm  Oil  (Group 2) | Emperor  Oil  (Group 3) | Golden Penny (Group 4) | King’s  Oil (Group 5) | Mamador  Oil  (Group 6) | Power  Oil  (Group 7) | F value | p value | Remark |
| T.CHOL  (mmol/L) | 1.26±0.24a | 1.20±0.11a | 1.79±0.29b | 2.20±0.24c | 2.03±0.25c | 1.83±0.26b | 2.45±0.42d | 16.87 | <0.0001 | S |
| HDL.C  (mmol/L) | 0.70±0.23a | 0.74±0.60a | 0.88±0.35a | 1.48±0.17b | 1.90±0.31b | 1.66±0.34b | 1.29±0.69c | 7.159 | <0.0001 | S |
| LDL.C  (mmol/L) | 0.27±0.15a | 0.31±0.39a | 0.74±0.12a | 0.67±0.31a | 0.15±0.14b | 0.24±0.13a | 0.86±0.77c | 3.569 | 0.0075 | S |
| TRIG.  (mmol/L) | 0.59±0.15a | 0.52±0.05a | 0.28±0.27b | 0.12±0.09b | 0.55±0.27a | 0.59±0.11a | 1.19±0.72c | 6.349 | 0.0001 | S |

**Keys**: T.CHOL =Total Cholesterol, HDL.C=High Density Lipoprotein, LDL.C=Low Density Lipoprotein, TRIG.=Triglyceride, S=Significant at p<0.05

**PostHoc:** Values in different rows differ significantly at p<0.05

a, b, c, & d superscripts: values in the same row but having different superscripts are significantly different from each other (p≤ 0.05)

**Table 2: Comparison of the Levels (Mean ± SD) of Omega-3 and Omega-6 in the different Groups of Wister rats Treated with Cooking Oils**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Control** (Group 1) | **Palm Oil** (Group 2) | **Emperor Oil** (Group 3) | **Golden Penny** (Group 4) | **King’s Oil** (Group 5) | **Mamador Oil**(Group 6) | **Power Oil** (Group 7) |
| Omega 3 | 8.64±3.73 | 12.14±954 | 12.01±3.99 | 12.82±9.07 | 7.86±3.95 | 9.11±5.60 | 9.96±2.86 |
| Omega 6 | 0.41±0.19 | 4.41±0.19 | 4.51±2.38 | 3.09±1.86 | 1.27±0.93 | 1.82±1.47 | 0.41±0.19 |
| p-value | 0.003 | 0.030 | 0.029 | 0.005 | 0.008 | 0.026 | 0.001 |
| t-value | 5.367 | 3.007 | 2.601 | 6.601 | 3.542 | 2.688 | 5.539 |

**Keys**: S = Significant at p <0.05

**PostHoc (Turkey’s):** Values in different rows differ significantly at p<0.05

**3.2: Comparison of the Omega 3 and Omega 6 Levels in the Different Brands of Cooking Oils**

The mean level of Omega-3 in the different rat groups treated with Palm Oil, Golden penny Oil and Emperor oil shows a significantly higher level (p<0.05) when compared with the Control group. In contrast, Kings Oil and Power Oil revealed a statistically lower mean level when compared with the control groups. Meanwhile, the mean level of Mamador oil did not show a significant difference (p>0.05) when compared with the control group, statistically speaking.

Relatedly, Emperor, Kings, Golden penny and Mamador Oils had significantly higher mean levels (p<0.05) of Omega-6 values (4.51±2.38b, 3.09±1.86c, 1.27±0.93d, and1.82±1.47d, respectively) when compared with the Control (0.41±0.19a). Meanwhile, there was no significant difference (p>0.05) between Palm Oil (0.41±0.19a), Power Oil (0.41±0.19a) and Control (0.41±0.19a) groups (Table 3).

**Table 3: Comparison of the Omega 3 and Omega 6 Mean Levels of the Different Brands in Groups of Rats Administered with Cooking Oils**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Omega 3** | **Omega 6** |
| Control (Group 1) | 8.64±3.73a | 0.41±0.19a |
| Palm Oil (Group 2) | 12.14±9.54b | 0.41±0.19a |
| Emperor (Group 3) | 12.01±3.99b | 4.51±2.38b |
| Golden Penny(Group 4) | 12.82±9.0b | 3.09±1.86c |
| Kings Oil (Group 5) | 7.86±3.95d | 1.27±0.93d |
| Mamador Oil (Group 6) | 9.11±5.60a | 1.82±1.47d |
| Power Oil (Group 7) | 6.96±2.86d | 0.41±0.19a |
| p-value | 0.035 | 0.001 |
| f-value  Remark | 0.874  S | 1.428  S |

**Keys**: S = Significant at p <0.05

**Post Hoc (Turkey’s):** Values in different columns differ significantly at p<0.05**:**

A, b, c, & d superscripts: values in the same row but having different superscripts are significantly different from each other (p≤ 0.05)

**3.3: Results of Omega-6 Components against Lipid Parameters in Wistar Rats Orally Administered Emperor Oil**

The association (correlation, Pearson’s) results of omega three components against lipid parameters in emperor oil identified a strong negative correlation between docosapentaenoic N6-Omega-6 and HDL (r=-0.99, p=0.04). There was a strong positive correlation between LDL and docosapentaenoic N6-Omega 6 (r=0.99, p=0.042) (Table 4).

**Table 4: Results of Omega-6 Components against Lipid Parameters in Wistar Rats**

**Orally Administered Emperor Oil**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameters | EicosadienoicAcidm Omega 6 | Docosatetraenoi | Docosapentaenoic N6-Omega 6 | TC | HDL | LDL | TG |
| Eicosadienoic Acid Omega 6 | r=1.00  p=0.00 |  |  |  |  |  |  |
| Docosatetraenoi | r=0.76  p=0.45 | r=1.00  p=0.00 |  |  |  |  |  |
| TC | r=0.98  p=0.12 | r=0.82  p=0.18 | r=0.83  p=0.37 | r=1.00  p=0.00 |  |  |  |
| HDL | r=-0.68  p=0.52 | r=-0.08  p=0.92 | **r=-0.99**  **p=0.04** | r=-0.23  p=0.66 | r=1.00  p=0.00 |  |  |
| LDL | r=-0.98  p=0.11 | r=-0.13  p=0.87 | **r=0.99**  **p=0.042** | r=0.14  p=0.79 | r=-0.147  p=0.779 | r=1.00  p=0.00 |  |
| TG | r=0.98  p=0.12 | r=0.81  p=0.19 | r=-0.45  p=0.70 | r=0.67  p=0.15 | r=0.04  p=0.92 | r=-0.404  p=0.426 | r=1.00  p=0.00 |

KEYS: r = Pearson’s correlation Coefficient, p Confidence Interval at p<0.05. LDL=Low Density Lipoprotein, HDL=High Density Lipoprotein, TC= Total Cholesterol, TG=Triglyceride

**3.4: Results of Omega-6 Components against Lipid Parameters in Wistar Rats Orally Administered Golden Penny Oil**

The association (correlation, Pearson’s) results of omega-6 components against lipid parameters in golden penny oil indicated a strong positive correlation between docosatetraenoic and docosapentaenoic N6-Omega 6 (r=0.89, p=0.016), total cholesterol and LDL (r=0.84, p=0.03), and total cholesterol and triglyceride (r=0.76, p=0.047) (Table 5).

**Table 5: Results of Omega 6 Components against Lipid Parameters in Wistar Rats Orally Administered Golden Penny Oil**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameters | Docosatetraenoic | Docosapentaenoic N6-Omega 6 | TC | HDL | LDL | TG |
| Docosatetraenoic acid | r=1.00  p=0.00 |  |  |  |  |  |
| Docosapentaenoic N6-Omega 6 | **r=0.89**  **p=0.016** | r=1.00  p=0.00 |  |  |  |  |
| TC | r=-0.04  p=0.93 | r=-0.41  p=0.41 | r=1.00  p=0.00 |  |  |  |
| HDL | r=0.47  p=0.34 | r=0.31  p=0.54 | r=-0.27  P=0.60 | r=1.00  p=0.00 |  |  |
| LDL | r=-0.35  p=0.49 | r=-0.51  p=0.29 | **r=0.84**  **p=0.03** | r=-0.73  p=0.09 | r=1.00  p=0.00 |  |
| TG | r=0.37  p=0.46 | r=0.10  p=0.84 | **r=0.76**  **p=0.047** | r=-0.31  p=0.54 | r=0.66  p=0.15 | r=1.00  p=0.00 |

KEYS: r = Pearson’s correlation Coefficient, p Confidence Interval at p<0.05. LDL=Low Density Lipoprotein, HDL=High Density Lipoprotein, TC= Total Cholesterol, TG=Triglyceride

**3.5: Results of Omega-6 Components against Lipid Parameters in Wistar Rats Orally Administered King’s Oil**

The association (correlation, Pearson’s) results of omega-6 components against lipid parameters in king’s oil showed no correlation between the lipid parameters and the omega-6 components (Table 6).

**Table 6: Results of Omega 6 Components against Lipid Parameters in Wistar Rats Orally Administered King’s Oil**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters | Docosapentaenoic N6-Omega 6 | TC | HDL | LDL | TG |
| Docosapentaenoic N6-Omega 6 | r=1.00  p=0.00 |  |  |  |  |
| TC | r=0.11  p=0.83 | r=0.11  p=0.83 |  |  |  |
| HDL | r=0.15  p=0.77 | r=0.95  p=0.003 | r=0.11  p=0.83 |  |  |
| LDL | r=0.06  p=0.90 | r=0.790  p=0.061 | r=0.89  p=0.016 | r=0.11  p=0.83 |  |
| TG | r=0.51  p=0.30 | r=0.761  p=0.047 | r=0.63  p=0.18 | r=0.53  p=0.28 | r=0.11  p=0.83 |

KEYS: r = Pearson’s correlation Coefficient, p Confidence Interval at p<0.05. LDL=Low Density Lipoprotein, HDL=High Density Lipoprotein, TC= Total Cholesterol, TG=Triglyceride

**3.6: Results of Omega 6 Components against Lipid Parameters in Wistar Rats Orally Administered Mamador Oil**

The association (correlation, Pearson’s) results of omega-6 components against lipid parameters in Mamador oil revealed some unexpected outcomes. No correlations were found between the lipid parameters and omega-6 components in the Mamador oil, which adds an intriguing element to our research (Table 7).

**Table 7: Results of Omega 6 Components against Lipid Parameters in Wistar Rats Orally Administered Mamador Oil**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters | Docosapentaenoic N6-Omega 6 | TC | HDL | LDL | TG |
| Docosapentaenoic N6-Omega 6 | r=1.00  p=0.00 |  |  |  |  |
| TC | r=-0.27  p=0.65 | r=1.00  p=0.00 |  |  |  |
| HDL | r=-0.81  p=0.09 | r=0.76  p=0.13 | r=1.00  p=0.00 |  |  |
| LDL | r=-0.48  p=0.41 | r=-0.16  p=0.78 | r=0.31  p=0.60 | r=1.00  p=0.00 |  |
| TG | r=-0.56  p=0.32 | r=-0.33  p=0.58 | r=0.13  p=0.83 | r=0.003  p=0.99 | r=1.00  p=0.00 |

KEYS: r = Pearson’s correlation Coefficient, p Confidence Interval at p<0.05. LDL=Low Density Lipoprotein, HDL=High Density Lipoprotein, TC= Total Cholesterol, TG=Triglyceride

**4.0 Discussions**

Our research focused on the impact of various cooking oils on lipid profiles in Wistar rats. The results indicated that the intake of different cooking oils significantly influenced lipid profiles. In particular, total cholesterol (T. CHOL) levels differed among groups; T. CHOL was considerably higher in Power Oil, followed by Golden Penny Oil, Kings’ Oil, Mamador Oil, and Emperor Oil compared to the control group. These results are significant as they offer vital insights into the possible health effects of these oils.

Power Oil showed the highest cholesterol levels, contrasting with the Control and Palm Oil groups, which had the lowest. The raised cholesterol levels, especially LDL-C, observed in the Power Oil group indicate a higher risk for cardiovascular diseases (CVD). In contrast, King’s Oil produced the lowest LDL-C levels and a notable rise in HDL-C, which is seen as beneficial cardioprotective.

Our results differ from those of Berkoh et al. (2024), who argued that vegetable oil consumption does not lead to dyslipidaemia nor affect the glycaemic control of metformin in type 2 diabetes management. This discrepancy may be due to the specific vegetable oil used in their research, groundnut oil derived from Arachis hypogaea. In contrast, our study employed oils from various sources, including palm olein (Emperor and Power Oil) and Golden Penny Oil from soya beans. These differences in oil origins might account for the variations in our results, highlighting the intricate nature of research in this area.

Our report is consistent with Ghobadi et al. (2019) and Voon et al. (2024), who observed that only olive oil raised triglyceride levels. This consistency with established research strengthens the credibility of our results. Similarly, the Power Oil group showed higher triglyceride levels, whereas Emperor Oil and Golden Penny Oil demonstrated lower levels. Elevated triglyceride levels are a notable risk factor for atherosclerosis and other cardiovascular disease events. (Balling *et al*., 2023; Aberra *et al*.*,* 2020).

The primary objection to using palm oil as cooking oil is its palmitic acid content, a saturated fatty acid that some argue may raise total cholesterol and LDL cholesterol levels. Nevertheless, numerous scientific studies involving animals and humans have demonstrated that palm oil intake does not lead to increased serum cholesterol levels and is not atherogenic. Besides palmitic acid, palm oil contains oleic and linoleic acids, which are classified as monounsaturated and polyunsaturated fats, respectively. It also offers vitamins A and E, which are known for their potent antioxidant properties. Research has shown that palm oil can protect the heart and blood vessels against plaque buildup and ischemic injuries. When included in a healthy, balanced diet, palm oil does not increase the risk of cardiovascular disease. (Odia *et al.,* 2015).

However, when comparing our findings with another study, Hisham et al. (2020) reported an elevation in total cholesterol upon consumption of palm oil, which does not align with our findings, where we observed no significant effect of palm oil consumption on total cholesterol, LDL, and HDL when compared with the control.

Sun et al. (2020) discovered that palm oil consumption raised both LDL and HDL levels compared to vegetable oils lower in saturated fat, as shown in their meta-analysis of clinical trials. However, our findings contrast with those of Sun et al. (2020). In contrast, evidence of low to very low certainty indicates that oils high in saturated fats, like palm oil, increase total cholesterol and LDL levels while also elevating high-density lipoprotein levels (Voon et al., 2024). Importantly, our results align with those of Phooi et al. (2019), which showed that palm olein does not affect lipid profiles in healthy adults compared to other oils. Additionally, our findings are consistent with the research by Alexandre et al. (2017), which also involved human subjects.

The average Omega-3 levels in all groups consuming various oils were significantly higher than the mean Omega-6 values. This trend was also evident in the control group. These results imply that the dietary oils may have boosted Omega-3 levels in the treated rats. The increased Omega-3 levels in these rats are likely attributable to the intentional enrichment of these cooking oils with Omega-3 by manufacturers to supply dietary eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Feizollahi et al., 2018). Additionally, it has been established that animal health professionals are supplementing animal feeds with Omega-3 to enhance overall health (Lee et al., 2019). This finding supports our study's results, as Omega-3 levels in the control animals were markedly higher than the average Omega-6 values.

**5. Conclusions**

This study analysed various brands of cooking oils, revealing essential omega-3 fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Samples D (Kings Oil), C (Golden Penny Oil), and A (Palm Oil) were identified as the richest sources of EPA. A notable amount of docosapentaenoic acid (DPA), another omega-6 fatty acid, was found in Sample C (Golden Penny Oil), Sample E (Mamador Oil), and Sample F (Power Oil). The lipid profiles of Wistar rats treated with Mamador, Golden Penny Oil, King's Oil, and Emperor Power Oil showed significant changes. In contrast, the palm oil group's lipid profile was not significantly different from the control group. The correlation among the various brands of cooking oils, including Palm Oil, Emperor Oil, Golden Penny Oil, Kings Oil, Mamador Oil, and Power Oil, demonstrated a complex relationship between lipid parameters and omega-3 and omega-6 fatty acids. These findings underscore the importance of making informed choices regarding omega fatty acids, considering their regulatory roles (both positive and negative) for heart health and future dietary recommendations.

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