

Original Research Article

A STUDY ON BIOCHEMICAL PROPERTIES AND EFFECTS OF DIFFERENT VEGETABLE OILS ON BLOOD INDICES IN WISTAR RATS.

ABSTRACT

Mustard oil is popular edible oil in Bangladesh. It contains about more than fifty percent erucic acid which is toxic to human beings. This study evaluated the determination of biochemical properties (acid value, iodine value, saponification value and unsaponifiable matter %) of mustard oil, virgin coconut and sesame oil and toxicity determination of these oils through blood indices targeting of these oil by mixing with normal diet as a dietary supplementation. This study found acid value of mustard, sesame and virgin coconut oil was 0.92, 0.312, 0.52 respectively. Iodine value of mustard, sesame and virgin coconut oil were 110.2, 105.2, and 11 respectively. Saponification value of wild mustard, sesame and virgin coconut oil was 171.1, 187.2 and 240 respectively and unsaponifiable matter % of mustard, sesame and virgin coconut oil was 1.19, 0.31 and 0.92 respectively. Also in vivo experiment we divided wistar male rats were 4 groups such as normal diet 12 gm/day/rat, mustard oil (MO) 0.6 gm/day/rat, virgin coconut oil (VCO) 0.6gm/day/rat and sesame oil (SO)0.6gm/day/rat. In this study the vegetable oil causes the effect on average body weight gain, Food Efficiency Ratio (FER), and lipid profiles [Total cholesterol (Tch), HDL- Cholesterol LDL - Cholesterol, Triglyceride (TG)] and serum enzymes [SGOT (AST), SGPT (ALT)] of different groups of rat also been estimated. The study found that mustard oil significantly ($p < 0.05$) increase lipid profile and enzymes SGOT, SGPT level in blood serum which is an indication of heart and liver disorder. The study found that coconut and sesame oil consumption in rat significantly ($p < 0.05$) decrease of these parameters.

Key words: Vegetable oils, biochemical properties, blood serum indices.

Introduction

Vegetables oils are used over and over again and even added to gravies and sauces. Although a lot of people in the world consume vegetable oil in order to fulfill their fat requirement by supplementing both omega-6 and omega-3 fatty acids, it has also been observed that a larger proportion of people depend on vegetable oil for this purpose. In this context the best example is Bangladesh. Mustard oils are most popular oils but sesame oil and coconut oils are also used for culinary purposes specially coastal area [1]. Among this mustard oils contains high levels of erucic acid (51.56-67.98%), which is poorly metabolized and consequently fats could be accumulated in heart muscle and evidently causes multiple organ dysfunctions especially heart and liver [2,3,4], besides some fatty materials could be deposited in the adrenal gland and ovarian tissues leading to some serious troubles on human [5]. Coconut oil contains approximately 90 % saturated fat. However, most of this oils are medium chain fatty (MCT) having 10 to 12 carbon atoms which are preferentially transported through the portal venous system to the liver. These fatty acids are available for oxidation and provide rapid source of energy [6]. The important feature of coconut oil is that it is responsible for increasing serum HDL cholesterol concentrations more profoundly than other sources of saturated fat [7, 8]. This is just because coconut oil is composed of a group of unique fat molecules known as medium-chain fatty acids (MCFA) [9,10]. Although they are technically classified as saturated fats, this fat can actually protect from heart attack or suffering a stroke. Natural, non-hydrogenated coconut oil tends to increase HDL cholesterol and improve the cholesterol profile. The study undertaken by Dr.T. Rajamohan and Nevin KG 2004 has also revealed that consumption of coconut oil in the general population did not elevate total cholesterol, LDL cholesterol or LDL cholesterol/ HDL cholesterol ratio. Consumption of coconut kernel with coconut oil had a beneficial effect that it

Comment [t1]: especially

46 reduced total cholesterol and lowered triglycerides. It also raised HDL cholesterol levels and lowered the LDL
47 cholesterol /HDL cholesterol ratio. The dietary practice of Kerala population consuming fresh coconut kernel and
48 coconut oil reduces the risk of coronary artery disease [11]. Kaunitz and Dayrit (1992) have reviewed some of the
49 epidemiological and experimental data regarding coconut-eating groups and noted that the available population
50 studies show that dietary coconut oil does not lead to high serum cholesterol or to high coronary heart disease
51 mortality or morbidity [12].

52 Sesame oil belongs to the oleic-linoleic acid group. It has less than 20% saturated fatty acid, mainly palmitic (7.9-
53 12%) and stearic (4.8-6.1%) acids. Oleic acid and linoleic acid constitute more than 80% of the total fatty acids in
54 sesame oil. Unlike other vegetable oils the percentages of oleic acid (35.9–42.3%) and linoleic acid (41.5–47.9%) in
55 the total fatty acids of sesame oil are nearest [13]. Sesame oil was reported to lower the absorption of fatty acid and
56 cholesterol in lymph by 50% when rats were fed diet containing 24% sesame oil as compared with control diet
57 containing no sesame oil [14]. As the lymphatic system is the major route for the transport of absorbed fatty acids
58 and cholesterol, serum and liver cholesterol levels were significantly reduced, especially LDL-cholesterol. Crude
59 lignan fraction separated from sesame oil was found to have a weak but significant hypocholesterolemic activity
60 [15]. The cholesterol-lowering activity depended on the dietary level of the lignans. Sesamin lowered intestinal
61 absorption of cholesterol by precipitating cholesterol from the bile acid micelles, and thus the serum cholesterol
62 level is reduced. The hypocholesterolemic effect of sesamin could be enhanced by α -tocopherol [16]. The
63 combination of α -tocopherol with sesamin has a practical value for the treatment of hypercholesterolemia. The
64 cholesterol-lowering effect of sesamin has also been demonstrated in humans with dietary supplementation of
65 sesamin at 64.8-mg/day level [17]. In the present study the chemical characteristics of mustard oils, coconut and
66 sesame oils are comparatively determined and then a group of adult male wistar rats have been treated with these
67 oils for effects on blood parameter.

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Materials and Methods

71 The following oils were taken under investigation:

- 72 1. Mustard oil
- 73 2. Coconut oil
- 74 3. Sesame oil

75

76

77 Collection of mustard and preparation of powder

78 Collection of sample is the main factor to start the whole research process. If the collection becomes erroneous then
79 the whole task will be useless. At first fresh, healthy and good quality mustard seeds were collected from the local
80 market of Kushtia, Natore and Pabna district in Bangladesh. The seeds were cleaned properly and sun dried to avoid
81 contamination. Then the seeds were stored at 4°C in refrigerator with sealed plastic packet to avoid the microbial
82 contamination. During preparation of experimental diet, stored mustard was taken out from the refrigerator (4°C)
83 and weighed amount of seeds were crushed and grinded by using electrical blender machine to obtain mustard
84 powder (MO). Mustard powder was used as a reservoir of mustard oil during the study.

85

86 Collection of coconut

87 Mature, healthy and good quality coconut was collected from the local market of Kushtia and Khulna district in
88 Bangladesh. After removal of husk, the hard outer layer was broken traditionally and the coconut water was drained
89 away. Then the mature, white and fresh flesh of coconut, which is known as virgin coconut kernel was collected.

90

91

92 Preparation of coconut oil

93 The coconut kernel was sundried continuously for 3 weeks to remove moisture content at 6% approximately. The
94 dried coconut kernel is known as “copra”. At this level, mold growth in copra is inhibited. Then the coconut meats
95 were cut by copra cutter to create a pulverized version of coconut meat. The resulted pulverized copra was pressed
96 in the mill to obtain oil. This is done with the help of small-scale expellers. The oil expeller is essentially a
97 mechanical screw press in which the copra is fed continuously and pressed twice until oil is expelled from the copra
98 by the pressure exerted by a continuous rotating warm shaft in the barrel or cage of the press. The barrel is built with
99 openings to allow the escape of oil and these can be adjusted according to the type of seed being crushed. The
100 combined oil from the first and the second pressing is collected in a tank.

101 102 Collection of Sesame Seed

103 Matured sesame seeds were collected from the local market of Kushtia and Khulna district in Bangladesh.

104 Preparation of Sesame oil

105
106 The collected seeds were then cleaned and dehulled manually. Then these dehulled seeds were passed through the
107 power driven mill. The machine squeezed the oil seed and oil from the kernel was collected in a bottle. After milling
108 the sesame oil were strained with a cloth and then allowed to settle. Finally clean layer of oil collected and preserved
109 for use.

110 111 Determination of biochemical properties of rapeseed oil

112 Iodine value

113 The iodine value of rapeseed oil was measured by the method of Hansberry et al., 1947[18].

Comment [t2]: Hansberry et al., [18]

114 115 Saponification value

116 Rapeseed oils were saponified with a known amount of potassium hydroxide, excess of which was determined by
117 titration [19].

118 119 Acid value

120 A weighed amount of materials were titrated with a suitable solvent in aqueous sodium hydroxide solution under
121 specific conditions, which did not saponify the neutral portion (Hansberry et al., 1947) [18].

Comment [t3]: delete this part

122 Unsaponifiable matter

123 The unsaponifiable matter is a fraction of fat or oil that remains insoluble after saponification of the fat sample by
124 alkali which was determined by titration [20].

125 126 Chemicals

127 Analytically grade biochemical kits for the estimation of total cholesterol (TC), high density lipoprotein (HDL), low
128 density lipoprotein (LDL), triglycerides (TG), Serum glutamic oxaloacetic transaminase (SGOT) or, aspartate
129 aminotransferase (AST) and Serum glutamic pyruvic transaminase (SGPT) or alanine aminotransferase (ALT) were
130 procured from Atlas medical, Cambridge, CB4 OWX, UK. Analytical process was done according to
131 manufacturer’s protocol.

132 Experimental animals and diet

133 Adult healthy Wistar male rats of age 5 weeks and average body weight of 90 to 110 g were purchased from the
134 Department of Jahangirnagar University, Savar Dhaka, Bangladesh. They were housed in poly carbonate cages with
135 steel wire tops and wood-cube bedding (5 rats per cage) at constant room temperature with relative humidity

Comment [t4]: mention the number of these rats

136 (55+5%) and 12h:12h dark-light cycle with available supply of distilled water and feed. The normal diet of the rats
 137 was the mixture of wheat flour (which contributes 30% of diet), molasses (which is a rich source of sugar mainly
 138 sucrose, glucose and fructose), and fish-meal that is an excellent source of protein.
 139

140 **Animal experimental design**

141 After one week of acclimatization with normal diet, Wistar rats were divided into four groups (n=5) named as A, B,
 142 C and D. Group-A is considered as control (normal diet) and Group-B to D groups were given 0.6 g mustard , 0.6 g
 143 coconut and 0.6 g sesame oil respectively per day with normal diet. According to Chakraborty (2003) 15% of erucic
 144 acid rich rapeseed oil is responsible for the development of heart lesion and Kramer (1992) 400 to 1500 mg/kg
 145 erucic acid significantly increased myocardial lipodosis in rats [42, 43]. This study was carried out over a six week
 146 period and body weight, supplied foods and water ad libitum were recorded daily.
 147

148 **Determination of average body weight gain and food efficiency ratio (FER)**

149 After 6 weeks, the average body weight gain and FER of each rat was calculated by the following equation: Cardiac
 150 lipodosis muscle and Body weight gain = (Final weight of average rat) – (Initial body weight) and Food efficiency
 151 ratio = Body weight gain / Food consumed.
 152

152 **Statistical analysis**

153 Statistical analysis was performed with SPSS for windows, version 11.5. Data were expressed as mean ± standard
 154 deviation (SD) or mean ± standard error (SE). Differences between the body weight of all groups and differences
 155 between serum indices of different groups of rats were analyzed using T-test. Significance was accepted at the
 156 p<0.05 and highly significance was accepted at the p<0.01 levels.
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 160

161 **RESULTS**

162
 163 This study indicated the biochemical properties of various vegetables oil have been determined. After conducting
 164 research study acid value of mustard , sesame and virgin coconut oil were 0.52, 0.312, and 0.392 respectively,
 165 iodine value of mustard , sesame and virgin coconut oil were 110.2, 105.2, and 11 respectively. Saponification
 166 value of wild mustard , sesame and virgin coconut oil were 171.1, 187.2 and 240 respectively and unsaponifiable
 167 matter of wild mustard , sesame and virgin coconut oil was 1.19, 0.31, 0.92 respectively[Table 1]. Among these
 168 comparatively coconut and sesame are more suitable oils than mustard oil.
 169
 170

171 **Table 1: Biochemical properties of different vegetable s oils**

Vegetables oils	Acid value ±SD	Iodine value ±SD	Saponification value ±SD	Unsaponifiable matter (%) ±SD
Wild mustard oil	0.52±0.07	110.2±0.70	171.1±3.20	1.19±0.18
Sesame oil	0.312±0.06	105.2±0.90	187.2±1.90	0.31±0.12
Virgin coconut oil	0.392±0.05	11.0±1.00	185.3±1.60	0.92±0.17

172 In this study average weight gain of group A, B, C, and D are indicated in table-2 and plotted in the Figure-1 were
 173 observed that after six weeks of feeding of rats. After this time we investigated weight gain were 69.93, 48.3, 65.33
 174 and 52.22 g for normal diet , mustard oil diet , coconut and sesame oil diet respectively . Which indicated that
 175

Comment [t5]: the author should illustrate how 0.6 g of oil were ensured to reach each rat as mentioned in abstract 0.6gm/day/rat.

Comment [t6]:

Comment [t7]: check reference style

Comment [t8]: check reference style

Comment [t9]: make in italic font

Comment [t10]: write full name for first time in text the abbreviation the next times

Comment [t11]:

Comment [t12]: analysis should be done by ANOVA as you have multiple comparisons (more than two)

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Comment [t15]: After this time weight gains were

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176 mustard oil supplemented diet can reduce weight. On the hand coconut and sesame oil increased weight of rats.
 177 Possibly reasons are mustard oils groups rat consumption sufficient food but nor absorb and metabolized properly.

Comment [t19]: replace by group consumed

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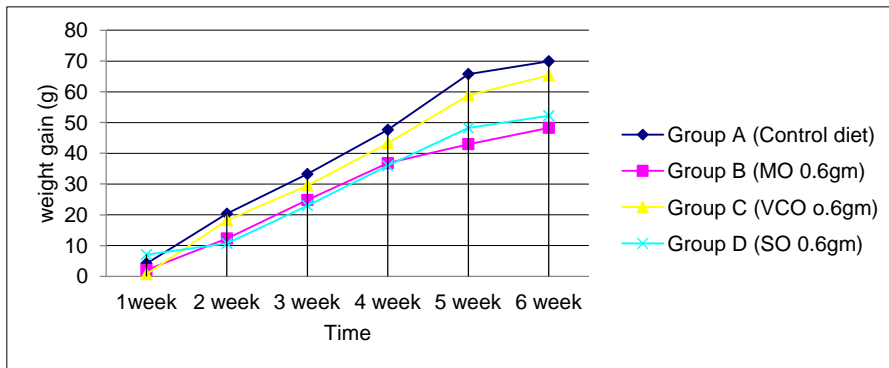
178
 179 **Figure 1:** The average weight body gain of the rats was measured for 6 weeks. The figure illustrates the mean
 180 values of body weight gain of the rats fed diet in combination with mustard oil, sesame oil, and virgin coconut oil.

Comment [t21]: this part could be transferred to discussion section

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181



182

183 Body weights measured as mean \pm SD. Group A= normal diet 12 gm, B= mustard oil diet 0.6gm, C= virgin
 184 coconut oil 0.6gm, D= sesame oil diet 0.6gm.

185

186

187

188 **Table 2** (FER) also showed the effect of mustards oils on food efficiency ratio (FER) of rats. The FER of Group A,
 189 B, C, and D were 0.115, 0.067, 0.131, and 0.100, respectively. The FER is significantly ($p < 0.05$) reduced of mustard
 190 oil supplemented diet group where as significantly improved of coconut and sesame oil groups (Group C and D).

Comment [t24]: please rephrase as it is not clear and had errors

191

192 **Table 2: Body weight gain and food efficiency ratio of rats.**

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193

Group	Initial Body Weight (g) \pm SD	Final Body Weight (g) \pm SD	Body weight gain (g) \pm SD	Change In body Weight (%) \pm SD	Food Intake \pm SD (g)	FER \pm SD
Group A (normal diet as control)	100.225 \pm 11.63	170.15 \pm 26.80	69.93 \pm 15.78	69.18 \pm 9.14	606.43 \pm 2.08	0.115 \pm 0.02
Group B (MO 0.6gm)	110.17 \pm 5.77	158.47 \pm 14.81	48.3 \pm 9.99	43.54 ^{**a} \pm 7.09	757.08 \pm 1.97	0.067 ^{**a} \pm 0.01
Group C (VCO 0.6gm)	106.83 \pm 5.67	172.16 \pm 19.52	65.33 \pm 15.19	61.16 ^{*b} \pm 4.13	496.05 \pm 2.44	0.131 ^{**b} \pm 0.01
Group D (SO 0.6gm)	110.83 \pm 14.45	163.05 \pm 18.04	52.22 \pm 10.85	47.72 \pm 6.39	522.39 \pm 1.28	0.100 ^{**b} \pm 0.01

194 Values are mean \pm SD, n=5

195 *Significant values $p < 0.05$ a Values significant differ from the normal diet

196 **High significant values $p < 0.01$ b values significant differ from the mustard

197

198

199

200 **Blood Serum Estimation**

201 After feeding of rats for 6 weeks we evaluated lipid profile and serum enzymes from blood found that total
 202 cholesterol were 35.59, 46.32, 33.33 and 35.65 mg / dl, HDL –cholesterol were 35.33, 38.24, 60.40 and 50.15 mg/dl
 203 , LDL –cholesterol were 7.00, 8.20, 6.66 and 6.43 mg/dl , Triglyceride level were 72.73,78.45,65.29 and 65.19 mg/
 204 dl, SGOT level were 110.04, 150.66, 107.36 and 105 u/l and SGPT level were 43.00,45.00, 40.00 and42.07 u/l
 205 respectively for normal diet , mustard oil group , coconut and sesame oil supplemented diet groups [Table 3].
 206 Mustard oil groups showed significant (p<0.05) adverse effect on both lipid profile and serum enzymes where as
 207 significant (p<0.05) positive effect on coconut and sesame oil treated groups on rats.
 208

Comment [t26]: please rephrase it is not understandable and filled with errors

209 **Table 3: Effects of vegetable oils on blood indices, total cholesterol(Tch), HDL-cholesterol LDL-
 210 cholesterol, triglycerides (TG), SGOT (AST)and SGPT (ALT).**

Group	T.Ch. (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	TG (mg/dl)	SGOT(u/l)	SGPT (u/l)
Group A (Normal diet 12g)	35.59 ±3.09	35.33±1.97	7.00±1.00	72.73±2.80	110.04±7.85	43.00±8.18
Group B (MO 0.6gm)	46.32* ^a ±1.51	38.24±7.57	8.20±2.52	78.45±8.86	150.66* ^a ±1.92	45.00±1.00
Group C (VCO 0.6gm)	33.33* ^b ±5.85	60.40* ^b ±4.76	6.66* ^b ±3.53	65.29±3.19	107.36* ^{a*^b} ±2.08	40.00±4.35
Group D (SO 0.6gm)	35.65* ^b ±4.87	50.15±7.48	6.43±1.40	65.19* ^b ±12.41	105* ^{a*^b} ±8.84	42.07±0.39

211 Values are mean ± SD, n=5

212 *Significant values p<0.05 a Values significant differ from the normal diet

213 **High significant values p<0.01 b values significant differ from the mustard

214 **Table 3** shows the biochemical analysis such as lipid profile (total cholesterol, HDL-cholesterol, LDL- cholesterol,
 215 triglycerides, , SGPT/ALT, and SGOT/AST of the serum of rats fed normal diet, MO and along with coconut oil and
 216 sesame oil with diet for 6 weeks.

217 **Discussion**

219 Biochemical properties are important indicator for quality of oil. In this study various vegetables oil has been
 220 determined. The study evaluated the acid value, iodine value, saponification value, unsaponifiable matter of
 221 mustard , sesame and virgin coconut oil . Acid value of mustard oil was higher than sesame and virgin coconut oil
 222 more susceptible to oxidation and tend to rancidity than other oil, where sesame oil contain certain natural
 223 antioxidant to prevent oxidation so acid value may lower due to this reason, where coconut oil is mainly composed
 224 of saturated fatty acid and lower unsaturation present in the carbon chain, where iodine value of virgin coconut oil
 225 was lower than mustard and sesame oil due to little unsaturation (double bond) present in the carbon chain.
 226 Saponification value of mustard oil was lower than sesame and virgin coconut oil which is an indication of good oil
 227 among these three oil. Unsaponifiable matter was higher in mustard oil than virgin coconut and sesame oil contain
 228 lower unsaponifiable matter . So from the view point of unsaponifiable matter of oil sesame oil is best among these
 229 three oils.

Comment [t27]: add "that make it "

Comment [t28]: replace by " that indicates it is "

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Comment [t30]: Table

Comment [t31]: rephrase as "the normal diet group was higher in weight gain than vegetable oil groups

Comment [t32]: declined

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230 In this study average weight gain of group A, B, C, and D are indicated in **table-2** and plotted in the **Figure-1** were
 231 observed that after six weeks of feeding of rats. Normal diet groups rats weight gain highest in comparison to other
 232 vegetable oils groups. Whereas mustard oil group rats decline weight than other groups [**Table 2**]. These have
 233 been indicated that the mustard oil induced rats began to lose weight after 6 weeks of treatment, possibly due to
 234 growth retarding activity caused by erucic acid. This result agreed with many researcher in previous studies
 235 [21,22,23,24]. Several mechanisms may be responsible for diminishing weight by mustard oil. There were many
 236 report published that erucic acid rich oil may cause cardiac lipidosis by accumulation of substantial fat in the heart
 237 muscle, induces myocardial lesion, affects peroxisomal β-oxidation enzyme system [25,26,27]. These injuries rats

238 tend to consume sufficient amount of food, but leading to ultimate weight loss. It might be caused metabolic
239 disorders they could not able to digest it.
240 **Table 2** also showed the effect of mustards oils on food efficiency ratio (FER) of rats. The FER of mustard oils
241 were significantly reduced than those of control rats (Group A) which satisfied the previous result [28]. This might
242 be due to the adverse effect of erucic acid. On the other hand, virgin coconut and sesame oil diet (Group C and D)
243 showed highly significant raised FER as compared to mustard oils diet (Group B). So, it could be suggested that
244 coconut oil and sesame oil supplemented food has positive effect over the negative impact of erucic acid containing
245 mustards oils supplemented foods group.
246

247 The lipid profile is a group of tests that are often ordered together to determine risk of coronary heart disease. They
248 are tests that have been shown to be good indicators of heart attack or stroke caused by blockage of blood vessels or
249 hardening of the arteries (atherosclerosis). Cholesterol travels through the blood attached to a protein. This
250 cholesterol-protein package is called a lipoprotein. Lipoprotein analysis (lipoprotein profile or lipid profile)
251 measures blood levels of total cholesterol (Tch), LDL- cholesterol, HDL- cholesterol, and triglycerides (TG). Rats
252 were fed experimental diet which was prepared by mixing mustard oil, virgin coconut oil and sesame oil 0.6g, 0.6g
253 and 0.6g respectively and the result presented in **table-3**. Mustard oil had showed highest elevation of total
254 cholesterol level than all other groups showed significant ($p<0.05$) increased in Tch compared to normal diet group.
255 This results have similarities with previous studied [29,30]. Many reporters have been reported that feeding high
256 levels of rapeseed oil to rats significantly increased cholesterol levels in the adrenal glands and lipidosi in the
257 cardiac tissue and also found that erucic acid may cause some adverse effect in lipid profile of serum [31].
258 Additionally when rats were fed to diet in combination with coconut oil and sesame oil exhibited significant
259 depletion of serum cholesterol level as compared to mustard oil and slightly increased than control group result
260 showed in **table-3**.

261 HDL is often called the good cholesterol that promotes cholesterol profile and helps to protect against heart disease
262 by scavenging and removing LDL cholesterol. HDL cholesterol helps to remove fat from the body by binding with it
263 in the bloodstream and carrying it back to the liver for disposal. The effects of different oils on serum HDL of rats
264 were shown in **table 3**. The results found that there was no significant changes between mustard oil diet (Group B)
265 and control diet (Group A). But when rats were fed a diet in combination with coconut oil showed significant
266 ($P<0.05$) elevation of HDL compared with mustard diet and also elevation of sesame oil supplemented diet
267 compared to mustard oil and normal diet (**Table 3**). According to Ajayi et.al, 5% sesame oil fed to rats increased
268 HDL-C in blood serum [32]. These findings indicated that coconut oil and sesame oil supposed to increase the HDL
269 level over erucic acid containing mustard oil.

270 The test for LDL cholesterol is used to predict the risk of developing heart diseases. Of all the forms of cholesterol
271 in the blood, the LDL cholesterol is considered the most important form in determining risk of heart disease.
272 LDL carries mostly fat and only a small amount of protein from the liver to other parts of the body. It is sometimes
273 called "bad cholesterol." A high LDL cholesterol level may increase the chances of developing heart disease. **Table**
274 **3** depicted the effect of experimental diets on blood serum LDL level in the experimental rats. The table showed
275 that mustard oil group increased LDL moderately while other groups (Group C and Group D) decreased LDL
276 cholesterol. Virgin coconut oil group significantly decrease LDL compared to mustards oil group (Group B and
277 C). The erucic acid containing mustard oil might be causative factor for increasing LDL. Other researcher also
278 showed this same phenomena [31]. In this study, it was found that sesame oil was decreased LDL than mustard oil
279 group.

280 Triglyceride is a part of a lipid profile, it may be used to monitor those who have risk factors for heart disease, Only
281 sesame oil diet had significantly lowest TG content ($p<0.05$) than mustard oil group while other diets had greater
282 ones[**Table 3**]. Although mustard oil group elevated triglyceride (TG) level. The sesame oil reduced TG ($p<0.05$)
283 which indicated the reduction of heart disease risk. The falloff this TG level may be due to the Linoleic acid and α -
284 linolenic acid which were found enormously in sesame oil and were involved in the metabolic pathway of
285 prostaglandin synthesis [33]. Another important component of sesame oil was lignin sesamin which also had an
286 effect on lipid metabolism [34]. Thus, this result indicated that mustard oil raised serum TG level and sesame oil is
287 supposed to minimize the TG level by the anti-lipidemic effect of sesame oil itself.

288 SGOT (AST) also an important inflammatory marker for heart inflammation. Mustard oil group showed significant
289 elevation of SGOT level than normal diet group (Group A) where as Coconut oil (Group C) and sesame oil group
290 (Group D) found significantly ($p<0.05$) depletion over than normal diet and mustard oil group [**Table 3**]. This
291 result also holds up the previous study [35]. But when rats were treated with coconut oil and sesame oil, SGOT level
292 was significantly ($P<0.05$) reduced. Thus, this result indicated that coconut oil or sesame oil had anti-inflammatory

Comment [t36]: please don't demonstrate results and table in discussion section

Comment [t37]: results of Carroll [28]

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Comment [t49]: to significantly deplet SGOT

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293 effect of heart which may be due to its HDL-C that mediates cholesterol efflux from the vasculature by reverse
294 cholesterol transport process and promotes antioxidant, anti-inflammatory, and anti-thrombotic effects [35, 22].
295

296 In addition, SGPT (ALT) was considered as a useful quantitative marker to describe the extent and type of
297 hepatocellular damage [36]. Elevated activity of liver enzymes represents the liver dysfunction. When the plasma
298 membrane of liver cell is damaged, the enzyme SGPT normally found in the cytosol is released into blood stream. In
299 our study, we also tried to evaluate the effect of mustard oil, coconut oil and sesame oil on the alteration of SGPT
300 enzyme activity. Results showed that elevation of SGPT level when rats were fed with mustard oil containing diet.
301 Surprisingly, food supplemented with coconut oil or sesame oil abrogated the elevation of SGPT activity level than
302 mustard oil rats [Table 3]. So it might be suggested that elevated level of SGPT by mustard oil on the other hand
303 coconut oil and sesame oil have its anti-inflammatory properties [37]. Sesame and coconut that have decreased the
304 SGPT level, possible it might be sesame oil contains lignan: sesamin, sesamol and high percentage of natural
305 antioxidant linolenic acid [38], those were active ingredient of sesame. Although coconut oil was considered as
306 saturated oil, many researchers recommended its antioxidant and anti-inflammatory properties [39,40, 41]. In our
307 study, we found that coconut oil could be more effective for prevention of myocardial lesion and hepatocellular
308 damage.
309

310 Conclusion

311 Mustard oil contains erucic acid which is harmful for health. The people of Bangladesh as well as India consume
312 this oil. Especially in rural area of our country use this oil. Our study showed among different varieties of vegetable
313 oils like mustard, coconut and sesame oil in Bangladesh. Though there is no significance changes of biochemical
314 characteristics among all vegetable oils but coconut and sesame are more preferable than mustard oil. On the
315 other hand in vivo experiment found that in mustard oil causes the weight loss as well as FER of the rats but when
316 rat fed food with virgin coconut and sesame oil causes the lifting of weight of rat also increase FER. Serum lipid
317 profile such as total cholesterol, LDL, TG which is raised by the incorporation of mustard oil where Sesame and
318 mustard oil decrease Tch, LDL, TG, and increase HDL level in serum which is good for cardiac health remove
319 excess LDL cholesterol from blood which is an indicator of heart diseases. Mustard oil also raised serum SGOT and
320 SGPT level which is an indicator of liver damage where virgin coconut and sesame oil decrease SGOT and SGPT
321 level. Virgin coconut and from the biochemical properties sesame and coconut oil consumption is preferable than
322 mustard. Because both oil less susceptible to oxidation and causing rancidity. This study suggests that if virgin
323 coconut and sesame oil used to eat regularly, it may protect toxic effect cause by erucic acid in human but must be
324 consume after proper purification for health safety.
325

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327
328 **Conflicts of Interest :** The author(s) declare(s) that there is no conflict of interest regarding the publication of this
329 manuscript.
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Comment [t56]: delete

Comment [t57]: delete

Comment [t58]: delete and put "that was clear from its biochemical properties versus sesame oil

Comment [t59]: rephrase

Comment [t60]: How this your aim to compare 2 oils with each other not to counteract effect of mustard oil by the other two oils

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