

A COMPARATIVE ANALYSIS OF TOTAL ANTIOXIDANT CAPACITY AND TOTAL FAT CONTENT OF DIFFERENT BRANDS AND SOURCES OF EDIBLE VEGETABLE OILS IN INDIA.

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ABSTRACT:The purpose of this study is to determine total antioxidant capacity and total fat content of different brands and sources of edible vegetable oils in India. The antioxidant capacity of oil samples was analyzed by Fe³⁺ ferric reducing power (ferric reducing antioxidant power assay, FRAP assay). Total lipid content was assayed by Phosphovanillin method.

Six brands of Sunflower oil were analyzed, among them brand three showed an optimum balance between the antioxidants and lipid content. Groundnut oil is one of the traditionally and predominantly used oil in the states of Maharashtra and Gujarat. The branded groundnut oil tested had high antioxidant capacity. Coconut oil is consisting of about 90% saturated fat it has got lower lipid content than rice bran oil and high antioxidant capacity. Mustard oil content is comparable to sesame oil but has a high antioxidant capacity, whereas palm oil has antioxidant capacity higher than Rice bran oil; it is one of the vegetable oils relatively high in saturated fats and thus Semi solid at room temperature hence not advisable for daily consumption.

Result of study helps in identifying the edible oil appropriate for daily consumption such that it has high antioxidant capacity but with low lipid content.

KEY WORDS: Edible vegetable oil, Seed oil, FRAP assay, Antioxidants.

INTRODUCTION: Antioxidants are substances or nutrients in our food which can prevent or slow the oxidative damage to our body. Oxidation reaction can produce free radicals, which start chain reactions that damage cells. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibit other oxidation reaction by being oxidized themselves. As a result, antioxidants are often reducing agents such as thiols or polyphenols^{1,2}. When our body cells use oxygen; they naturally produce free radicals which can cause damage. Antioxidant act as "free radical scavengers" and hence prevent and repair damage done by these free radicals. Health problems such as heart disease, muscular degeneration, diabetes, cancer is all contributed by oxidative damage^{1,2}.

Although Oxidation reaction are crucial for life, they can also be damaging; hence, plants and animals maintain Complex system of multiple types of antioxidants such as glutathione, Vitamin C and Vitamin E as well as enzymes such as catalase, superoxide dismutase and various peroxidases. Low levels of antioxidants, or inhibition of the antioxidant enzymes, causes oxidative stress and may damage or Kill cells^{3,4}.

Antioxidants are also widely used as ingredients in dietary supplements in the hope of maintaining health and preventing diseases such as cancer and coronary heart disease⁵.

Antioxidants are classified into two broad divisions, depending on whether they are soluble in water (hydrophilic) or in lipids (hydrophobic)^{6,7}. In general, water soluble antioxidants react with oxidants in the cell cytoplasm and the blood plasma, while lipid soluble antioxidants protect cell membrane from lipid peroxidation. These compounds may be synthesized in the body or obtained from the diet^{6,7,8}.

Phenolic compounds and ascorbic acid are the most important natural antioxidants. Phenolic compounds such as tocopherols, polyphenols, phenolic acid and lignans are widely distributed

in plants⁹. Phenols are more frequently found in vegetable oil than animal fats especially soybean oil, canola, sunflower, corn and palm oils. The refining process especially the deodorisation reduces tocopherol contents in oils. carotene is the major carotenoid in oils and beta carotene is the most study. Palm oil is one of the richest sources of carotene oils. Crude oils contains phospholipids but most of them are removed by oil processing such as degumming^{10,11}. Oils that are consumed without refining contain higher amount of phospholipids. Crude soybean oil contain phosphatidylcholine and phosphatidyl ethanolamine¹⁰.

Antioxidants are found in varying amounts in foods such as vegetables, fruits, grain, cereals, legumes and nuts. Some antioxidants such as lycopene and ascorbic acid can be destroyed by long term storage or prolonged cooking. Other antioxidant compounds are more stable, such as polyphenolic antioxidants in foods like whole wheat cereals and tea. In general, processed foods contain less antioxidants than fresh and uncooked foods, since the preparation processes may expose the food oxygen^{11,12}.

Lipids play diverse and important roles in nutrition and health. However, there is also considerable awareness that abnormal levels of certain lipids, particularly cholesterol and trans fatty acids are risk factors for heart disease amongst others¹³.

Humans have requirement for certain essential fatty acids, such as linoleic acid (an omega 6 fatty acid) and Alpha linolenic acid(an omega 3 fatty acid) in the diet because they cannot be synthesized from simple precursors in the diet¹⁴. Both of these fatty acids are 18 carbon polyunsaturated fatty acids differing in the number and position of the double bonds. Most Vegetable oils are rich in linoleic acid (Safflower, sunflower and corn oils). Alpha linolenic acid is found in the green leaves of plants and in selected seeds, nuts, and legumes (flax, canola, walnuts and soy^{15,16}). Fish oils are particularly rich in the longer chain omega 6 fatty acids

eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Most of the lipid found in food is in the form of triacylglycerols, cholesterol and phospholipids¹⁵.

Saturated fats have a profound hypercholesterolemic (increase blood cholesterol levels) effect and tend to increase plasma LDL¹⁶. They are found predominantly in animal products (butter, cheese and meat) but coconut oil and palm oil are common vegetable sources. Intake of monounsaturated fats in oils such as olive oil is thought to be preferable to consumption of polyunsaturated fats in oils such as corn oil because the monounsaturated fats apparently do not lower high-density lipoprotein (HDL) cholesterol levels. Keeping cholesterol in the normal range not only helps prevent heart attacks and strokes but may also prevent the progression of atherosclerosis^{16,17,18}.

MATERIALS AND METHODS: 2,4,6 tripyridyl-s-triazine and ferric chloride were purchased from Sigma chemical Inc, USA. All other reagents and chemicals used were of analytical grade from local sources. Oil samples from various sources were sunflower, extra virgin olive, groundnut, mustard, and sesame oils were purchased in local markets. Both branded samples and unbranded samples were used. Some oil samples are unprocessed samples obtained from local markets of Navi Mumbai, Maharashtra, India. The samples were analyzed separately, and data presented as mean value. Each oil sample was diluted in ethanol (1 :1000) for both total antioxidant capacity and total lipid content estimation. Extra virgin olive oil was used as standard. Estimation of total antioxidant capacity was done by the FRAP assay¹⁹ and the total lipid content was done by phosphovanilline method²⁰.

OBSERVATION AND RESULTS:

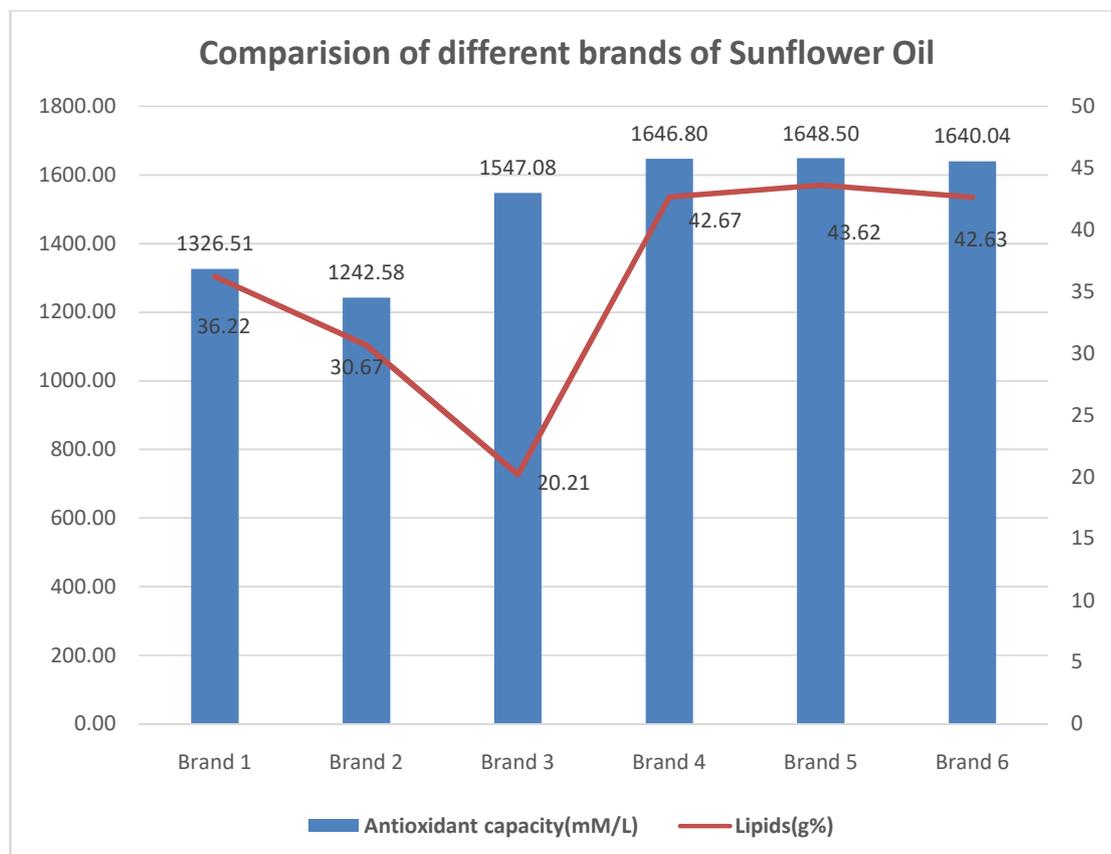
Sunflower oils: six brands of Sunflower oils were analyzed. Brand one, two, four, five and six had comparable lipid level while brand three had the lowest lipid level. Brand four and five had

comparable antioxidant levels. Brand one and two had comparable but significantly lower antioxidant levels as compared to that of brand four, five and six. Brand three in spite having lowest lipid content (50% lower as compared to other brands) had sufficiently higher antioxidant capacity. (Table 1 and Graph 1)

Table 1: Comparison of different brands of Sunflower oils.

Sunflower Oils	Antioxidant capacity(mM/L)	Lipids(g%)
Brand 1	1326.51	36.22
Brand 2	1242.58	30.67
Brand 3	1547.08	20.21
Brand 4	1646.80	42.67
Brand 5	1648.50	43.62
Brand 6	1640.04	42.63

Graph 1:

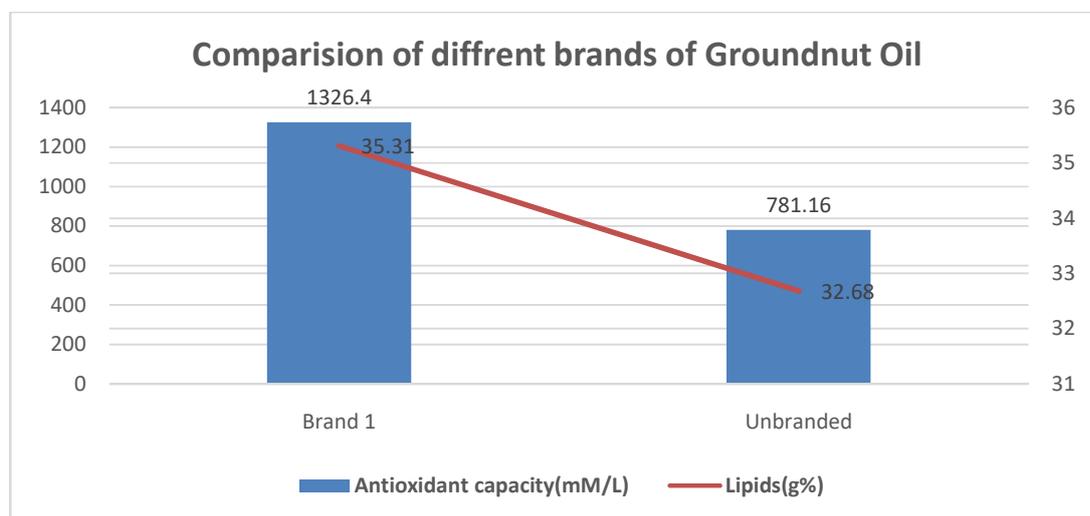


Groundnut oils: Two brands were analyzed. Though the lipid content was almost the same for both the brands, the antioxidant capacity of brand one was significantly higher than brand two. (Table 2 and Graph 2).

Table 2: Comparison branded and unbranded Groundnut oils.

Groundnut oils	Antioxidant capacity(mM/L)	Lipids(g%)
Brand 1	1326.40	35.31
Unbranded	781.16	32.68

Graph 2:

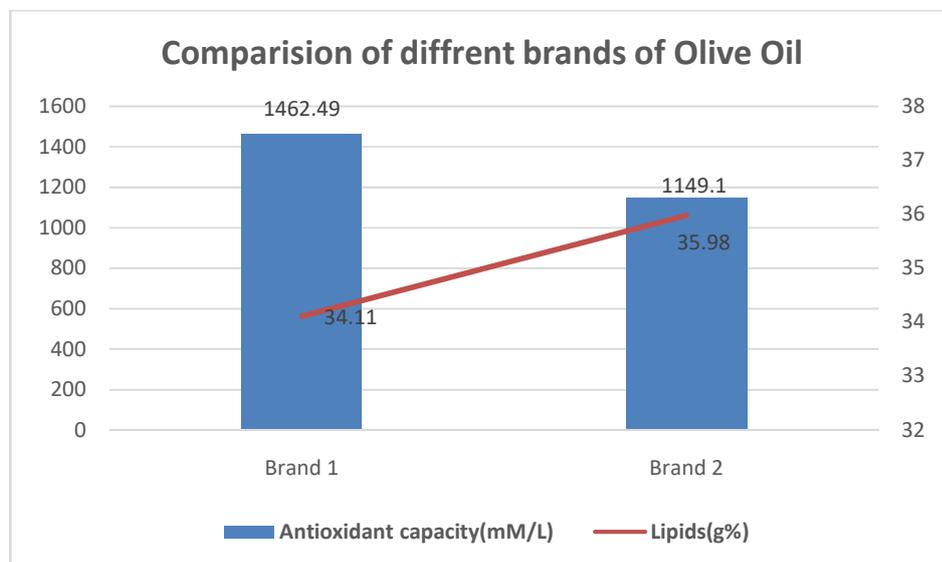


Olive oils: Two brands of olive oils were tested. Both have comparable lipid content as well as antioxidant capacity.(Table3, Graph3)

Table 3: Comparison between branded Olive oil.

Olive oils	Antioxidant capacity(mM/L)	Lipids(g%)
Brand 1	1462.49	34.11
Brand 2	1149.10	35.98

Graph 3:

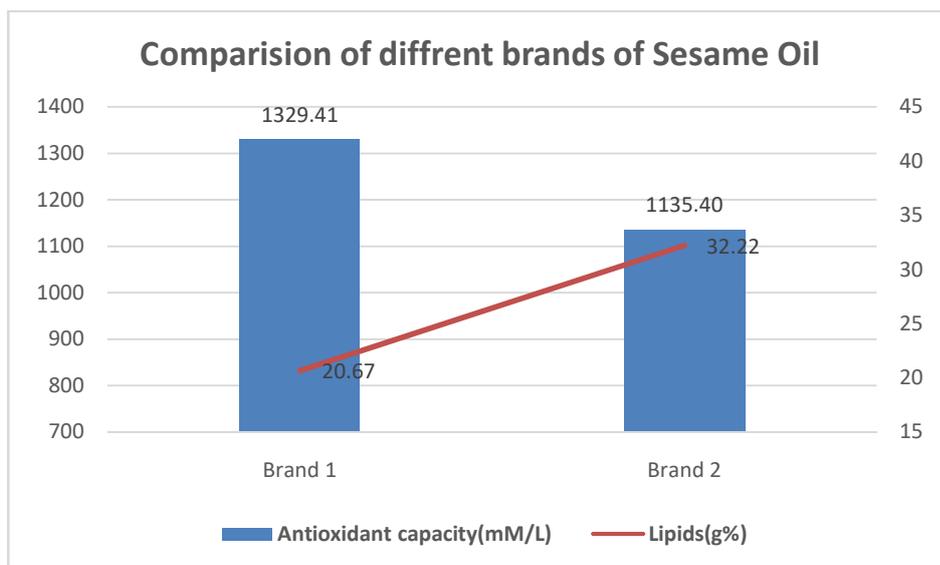


Sesame oils: one branded and one unbranded sample were analyzed. The unbranded oil had lower antioxidant capacity although the lipid content was comparable.(Table 4 and Graph4).

Table 4: Comparison of different brands of Sesame oil.

Sesame oils	Antioxidant capacity(mM/L)	Lipids(g%)
Brand 1	1329.41	20.67
Brand 2	1135.40	32.22

Graph 4:

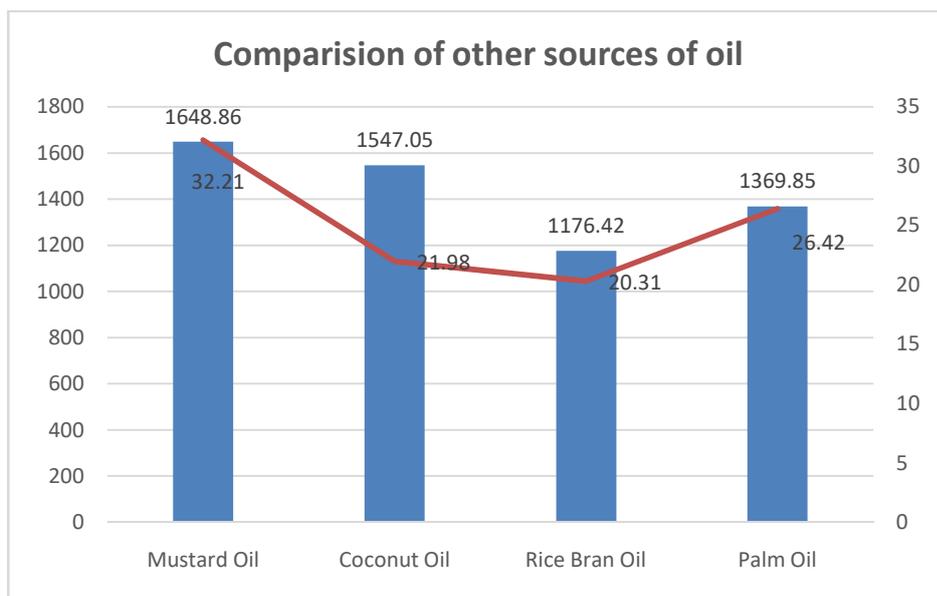


Other sources: only one brand of each of the mustard, coconut, rice bran, palm oil was analyzed.

Table 5: Comparison of other sources of oils.

Other sources of oils	Antioxidant capacity (mM/L)	Lipids (g%)
Mustard Oil	1648.86	32.21
Coconut Oil	1547.05	21.98
Rice Bran Oil	1176.42	20.31
Palm Oil	1369.85	26.42

Graph 5:



Rice bran oil had the lowest lipid content as well as the antioxidant capacity. Coconut oil had slightly higher lipid content than rice bran oil but much higher antioxidant capacity. Palm oil had higher lipid content but lower antioxidant capacity than coconut oil. Mustard oil has the highest lipid content as well as antioxidant capacity.(Table 5 and Graph 5).

DISCUSSION:Vegetable fats and oils are substances derived from plants that are composed of triglycerides¹⁰.Normally,oils are liquid at room temperature and fats are solid. Six brands of Sunflower oil wereanalyzed. Among them brand three showed an optimum balance between the antioxidants andlipid content. Sunflower oil contains predominantly linoleic acid in triglyceride form. It is high inthe essential Vitamin E and low in saturated fat⁵.Groundnut oil is one of the traditionally and predominantly used oil in the states of Maharashtraand Gujarat as groundnuts are cultivated in large amounts here. The branded oil tested had highantioxidant capacity. They contain MUFA which help to lower LDL in our body without loweringthe levels of HDL.In wake of aping western lifestyle, we have started using olive oils though not the native of ourcountry.

Olive oils have highest lipid content (among the sources tested) and a low antioxidant capacity. It has Monounsaturated fat and is the preferred cooking oil in Mediterranean countries.

It is not advocated for the common Indian. Asian sesame oil derives its dark colour and flavour from toasted hulled sesame seeds. It is commonly used in South Indian, Chinese and Korean cuisine¹⁵. Two brands of this oil were tested.

Sesame oil is considered more stable than most vegetable oils due to antioxidants in the oil¹⁶.

Sesame oil is least prone, among cooking oils to turn rancid. This is because it has a very high boiling point. In effect, sesame oil retains its natural structure and does not break down even when heated to a very high temperature.

Only one brand of each of the mustard, coconut rice bran, palm oil was analyzed. Rice bran oil said to prevent absorption of lipids and hence is advocated to hyperlipidemic patients to lower blood triglycerides level. It is rich in monounsaturated fatty acid and has cholesterol lowering properties due to the presence of minor component called oryzanol.

Coconut oil is a fat consisting of about 90% saturated fat. The oil contains predominantly medium chain triglycerides²² with roughly 92% saturated fatty acids, 6% monounsaturated fatty acids and 2% polyunsaturated fatty acids. It is mainly used in coastal areas and Southern states of India. It has got lower lipid content than rice bran oil and a high antioxidant capacity.

Mustard oil is composed of the fatty acid, oleic acid, linoleic acid and erucic acid¹⁷ In India mustard oil is generally heated almost to smoking before it is used for cooking; this may be an attempt to reduce the content of noxious substances and does reduce the strong smell and taste. The lipid content is comparable to sesame oil but has a high antioxidant capacity. It is Predominantly used in the states of West Bengal, Uttar Pradesh and Punjab.

Palm oil itself is reddish because it contains a high amount of beta-carotene. It is used as cooking oil, to make margarine and is a component of many processed foods. It has antioxidant capacity

higher than rice bran oil. Palm oil is one of the few vegetable oils relatively high in saturated fats and thus semi solid at room temperature, hence not advisable for daily consumption.

CONCLUSION: Many edible vegetable oils are used for various purposes in cooking and food preparation. Lipids play diverse and important roles in nutrition and health. Many lipids are absolutely essential for life. Humans have a requirement for certain essential fatty acids such as linoleic acid and alpha-linoleic acid in the diet because they cannot be synthesized from simple precursors in the diet. An appropriate amount of dietary fat is necessary to facilitate absorption of fat soluble vitamins (A,D,E,K) and carotenoids.

The data obtained through the samples helps to identify the oil appropriate for daily consumption. As we know we don't absorb more than 3% fat hence it is advisable to use food items containing less than 3% fat. Oil-free diet may deny a person from the essential antioxidants required. Minimum amount of oil in day to day routine is advisable depending on the age group and physical activity is advisable. Traditionally cultivated oil seed in the region is advisable to balance the lifestyle and food habits. Diet devoid of oil is not good as they contain important nutritive components like antioxidants. Hence through the above research the choice for the appropriate vegetable edible oil has been made simpler.

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