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A COMPARATIVE STUDY OF TOTAL ANTIOXIDANT CAPACITY & TOTAL FAT CONTENT IN VARIOUS BRANDS & SOURCES OF MILK AVAILABLE IN INDIA

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ABSTRACT

The purpose of this study is to determine Total antioxidant Capacity & Total lipid content in various brands & sources of milk available in India. The antioxidant capacity of milk samples was analyzed by using Fe^{3+} reducing power (ferric reducing antioxidant power assay, FRAP). Total lipid content was assayed by Phosphovanillin method. Buffalo milk has high lipid content as well as antioxidants. Cow milk has almost 50% and 25-40% lipid and antioxidant capacity respectively lower than that of buffalo milk. Goat milk shows with a lower lipid content and high antioxidant capacity and hence ideal source. The result of this study helps in identifying the milk appropriate for daily consumption such that it has high antioxidant capacity but at the same time low lipid content.

Keywords: Antioxidant; Milk, Fat content

1. INTRODUCTION

A paradox in metabolism is that while the vast majority of complex life requires oxygen for its existence, oxygen is a highly reactive molecule that damages living organisms by producing reactive oxygen species [1]. Consequently, organisms contain a complex network of antioxidant metabolites and enzymes that work together to prevent oxidative damage to cellular components such as DNA, proteins and lipids [2, 3]. In general, antioxidant systems either prevent these reactive species from being formed, or remove them before they can damage vital components of the cell. Oxidative stress by free radicals is an important event in cell that can cause aging and degenerative diseases including cancer, heart diseases, multiple sclerosis, Parkinson's disease, autoimmune diseases and senile dementia [4]. Stress, physical damage, viral infection and cytotoxic or carcinogenic compounds, as a consequence of chemical or biological aggression, may cause peroxidation of polyunsaturated fatty acids of cell membranes and liberation of toxic substances such as free radicals [4]. Studies concerning the relationship between the mortality due to cancer and heart diseases, and consumption of fruits and vegetables indicated that polyphenols, being present in large amounts in fruits and vegetables, have a significant decreasing effect on the mortality rate from these diseases [1-3]. On the other hand, oxidation of lipids, which occurs during raw material storage, processing, heat-treatment and storage of final products, is one of the basic processes causing rancidity of food products and their deterioration [3, 4]. Due to undesirable effects of oxidized lipids on human, it seems essential to decrease contact with products of lipid oxidation in food [4]. In order to prolong the storage stability of foods, synthetic antioxidants are used in industrial processing. However, the side effects of some synthetic antioxidants used in food processing such as butylated hydroxytoluene (BHT) and butylatedhydroxyanisole (BHA) have already been documented. For example, these substances can show carcinogenic effects in living organisms [5, 6]. Therefore, authorities of government and consumers are concerned about the safety of the food products and the potential effects of synthetic additives on human health [6, 7].Many species of fruits, vegetables, herbs, cereals, sprouts and seeds have been investigated for antioxidant activity during the past decade [8]. Natural antioxidants are being extensively studied for their ability to protect organisms and cells from damage caused by oxidative stress which is considered as a cause of ageing and degenerative diseases [9]. Increased incidences of metabolic diseases have led the consumers to make healthy choices of foods and demand for functional foods is mounting across the world [9]. Changing life styles have led the food industry and researchers to develop functional foods and determine the functional value of traditional foods [10]. Increased knowledge in free radical biology has led the consumer to consume functional foods containing natural antioxidants. Casein, whey, sulphur containing amino acids, selenium, zinc, catalase, glutathione peroxidase, superoxide dismutase, vitamin E, C and beta-carotene has antioxidant activity in milk [8]. Concentration of vitamin E in buffalo and cow milk is 5.5 and 2.1 mg/100 ml, respectively while the amount of vitamin C in buffalo and cow milk is 3.66 and 0.94 mg/100 ml, respectively [9]. Buffalo milk has higher magnitude of sulphur containing amino acids, selenium and zinc as compared to cow milk [10]. Concentration of beta carotene in cow milk is more than buffalo milk. Due to the difference in the concentration of antioxidant substances, buffalo and cow milks may have different antioxidant capacity.

2. MATERIALS AND METHODS

2.1. Chemicals and reagents

2, 4, 6-tripyridyl-s-triazine (TPTZ) and Ferric Chloride were obtained from Sigma Chemical Inc, USA. All other reagents and chemicals used were of analytical grade procured from local sources.

2.2. Sample Collection and Extraction

Milk samples procured from various animal and plant sources such as cow, buffalo, goat, plant source (Soy milk) from particular dairies and markets in Navi Mumbai, Maharashtra, India. The samples were analyzed separately and data presented as mean value. Each sample was extracted induplicate according to Sing et al. and Zielinski et al. [11, 12]. Methanol extraction was adopted as per the procedure described by Matthaus [13]. 5ml sample was taken and extracts were prepared in 20 ml of 70%Methanol containing 0.1% HCl by shaking vigorously for four hours at room temperature. The sample suspension was centrifuged at 10,000 g for 15min at 10°C, the supernatant was collected and filtered through the Whatman #1 filter paper. Raw milk (i.e. unboiled) was used for analysis as heating might destroy antioxidants and thus give an incorrect value. Estimation of total antioxidant was done by the FRAP assay [14] and the total lipid content was done by Phosphovanilline method [15].

3. RESULTS

3.1. Buffalo milk

Five milk samples were analyzed. Two were branded and other three were loose packets (unbranded) obtained from milk man. Buffalo milk has high lipid content as well as antioxidants. The branded milk as well as the milk bought from the milk man as loose packets had comparable antioxidant capacity and lipid content (Table 1 and Fig. 1).

Table 1: Antioxidant capacity & Total Lipid Content in different brands of Buffalo Milk

Buffalo milk	Antioxidant Capacity (μM/L)	Total Lipids (g%)
Brand 1	11468.52	0.750
Brand 2	11421.56	0.742
Loose Milk	12154.62	0.726
Loose Milk	12050.60	0.712
Loose Milk	12148.70	0.723

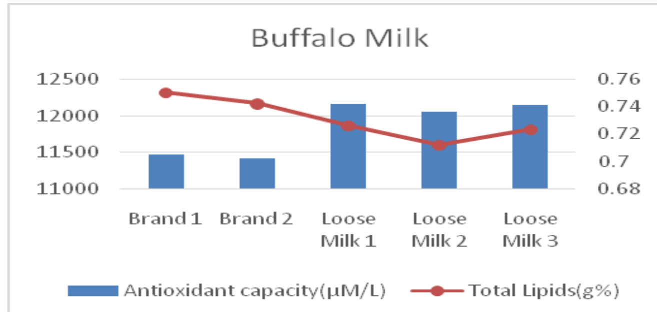

Fig. 1: Comparative analysis of Antioxidant capacity & Total Lipid Content in Buffalo Milk

3.2. Cow milk

Twelve branded samples of cow milk were analyzed. Brands 2, 5, 6, 7, 8 and 9 had comparable total lipid content while brands 1, 3, 4, 10, 11, 12 had higher and comparable levels of lipid content. Brand 3 had the lowest antioxidant capacity. Brands 2, 3, 5, 8, 9 and 11 had comparable antioxidant capacity, while brand 1, 4, 6, 10 were comparable to each other but higher than brands 2, 3, 5, 8, 9, 11. Brand 7 and 12 had the highest antioxidant capacity and was significantly higher than the others.

Table 2: Antioxidant capacity & Total Lipid Content in different brands of Cow Milk

Cow Milk	Antioxidant capacity (μM/L)	Total Lipids (g%)
Brand 1	4685.16	0.410
Brand 2	2246.15	0.315
Brand 3	2026.12	0.460
Brand 4	4260.12	0.401
Brand 5	2648.50	0.316
Brand 6	4680.52	0.380
Brand 7	5868.28	0.382
Brand 8	3702.29	0.421
Brand 9	3526.30	0.335
Brand 10	4682.13	0.421
Brand 11	3867.12	0.362
Brand 12	5468.15	0.368

The general trend among the twelve samples analyzed is higher the lipid content higher the antioxidant capacity. Brand 7 and 12 was an exception which had lower lipid content but the highest antioxidant capacity. It is possible that along with the preservatives external source antioxidants are supplemented in these brands (Table 2 and Fig. 2).

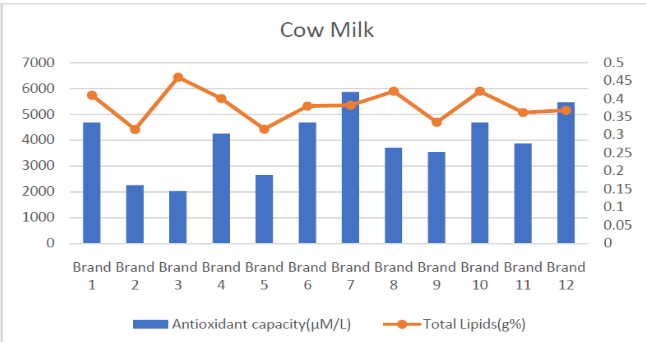

Fig. 2: Comparative analysis of Antioxidant capacity & Total Lipid Content in Cow Milk

3.3. Other Sources of Milk

Only one sample each of unbranded goat and branded soy milk was analyzed. Goat milk shows comparable lipid content and antioxidant capacity to that brand 7 and 12 of cow milk.

Soy milk has comparable lipid content to cow milk but much higher antioxidant capacity (approximately 40%-50%) (Table 3 and Fig. 3).

Table 3: Antioxidant capacity & Total Lipid Content in other sources of Milk

Other Sources	Antioxidant capacity (µM/L)	Total Lipids (g%)
Goat Milk	6782.50	0.368
Soy Milk	8672.32	0.412

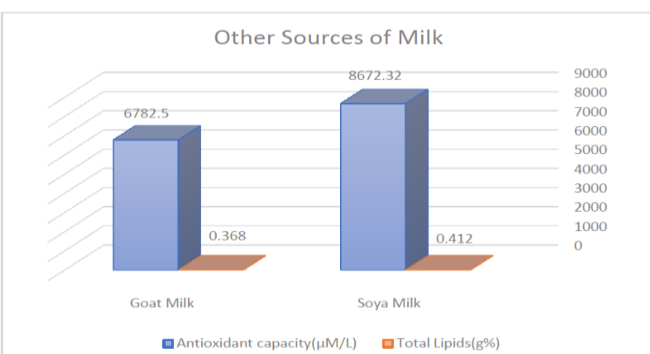

Fig. 3: Comparative analysis of Antioxidant capacity & Total Lipid Content in other sources of Milk

4. DISCUSSION

The composition of milk differs widely between species. Factors such as the type of protein; the proportion of protein, fat, and sugar; the levels of various vitamins and minerals [16].The composition of fats present in the animal body depends on the animal, weather and kind of feed. Fats present in plants are predominantly unsaturated and long chain as compared to that of mammals [16, 17]. This is due to considerable hydrogenation of unsaturated dietary fats occurring in their rumen [17]. Ruminant milk fat are said to contain a considerable percentage of short chain fatty acid which are products of microbial metabolism [16].

Buffalo milk ha high lipid contents well as antioxidants. High lipid content reflects high antioxidant status. The branded milk as well as the milk from the loose packets had comparable antioxidant capacity and lipid content. Since both branded and unbranded milk had comparable antioxidants and lipids hence the unbranded source analyzed can be said to be untampered.

Cow milk had almost 50% and 25-40% lipid and antioxidant capacity respectively lower than as that of buffalo milk. It is known that buffalo milk has higher fat content as compared to cow milk. Among the twelve brands of cow milk analyzed, brand 7 and 12 showed low lipid content and high antioxidant capacity. It is possible that antioxidant was externally supplemented to counteract the effect of storage. In general the lipid content of cow milk is lower and hence the antioxidant capacity. It is known that more than 3% dietary fat is not absorbed by humans and hence cow's milk could be an ideal source of lipid intake with sufficient antioxidant capacity that can be supplemented from other plant sources.

Unbranded Goat milk analyzed shows with a lower lipid content and high antioxidant capacity and hence an ideal source. However, the availability is very limited in most parts of the Indian sub-continent. Soya milk is plant source but advocated as it has a high antioxidant capacity and comparable lipid content to cow milk. It is specifically useful in case of infants who have lactose intolerance. However due to its different taste, it is not very commonly used by majority of Indian population, particularly children.

5. CONCLUSION

The data obtained through the samples helps to identify the milk 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. Therefore, cow milk is an ideal source for lipids as well as antioxidants. Soy milk is also good for people suffering from lactose intolerance as it has good amount of antioxidants as well as good source of proteins.

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