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Bioactive Lipids and Phospholipids Classes of Buffalo and Goat Milk Affected by Seasonal Variations

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Abstract:

This research was figuring out the impact of seasonal variations on bioactive lipids content in both Egyptian buffalo and goat milk. Thirty-two samples of buffalo-milk and eighteen goat milk samples were collected and well- mixed to obtain 4 and 3 composite samples respectively. **C**hemical composition, total conjugated diene ($C_{18:2}$) & triene ($C_{18:3}$) and fatty acids profile were estimated using GC-MS apparatus. Phospholipids (PLs) were determined using ^{31}P-NMR technique. Data detected that buffalo and goat milk contained higher contents of Butyric acid (BA) in winter than summer. Results manifested that total Odd and Branched Chain Fatty Acids (OBCFAs) contents of buffalo milk were higher during summer than in winter. Buffalo milk had higher total PLs either in summer or winter seasons than goat milk. Goat milk had higher contents of Phosphatidylcholine (PC), phosphatidylethanolamine (PE), sphingomyelin (SM) and phosphatidylglycerol (PG) but buffalo milk had higher content of phosphatidylserine (PS) and phosphatidylinositol (PI).

Key words: Buffalo milk**, goat** milk, bioactive lipids, butyric acid, conjugated diene and triene acids, conjugated linoleic acid, phospholipids.

1- Introduction

Milk fat is a source of energy and fat soluble vitamins, and it considered typical transport system for plentiful fatty acids associated with enhanced human health. Fatty acids (FAs) of milk fat emerge from two main sources: synthesis *de novo* in the mammary glands and the plasma lipids originating from the feed. So, the species or the type of animal affected their distribution. The fatty acids that are synthesized *de novo* are short and medium-chain length acids, from 4:0 to 14:0 and have also some 16:0, whilst the C18-fatty acids and some of 16:0 arise from the plasma lipids. *De novo* fatty acid synthesis accounts about 40% (w/w) of the total fatty acids in milk fat, while lipids of dietary origin gained the rest. **[34].** Over the past few years, scientific proof has appeared that lipid-bioactive substances can lower the risk of some diseases **[25]**

In **(2010); Evans & Hutchinson** defined the bioactive lipids as active specific signaling pathway are participatory in the regulation and maintenance of normal body, functions, and allowing cells to respond appropriately . Milk bioactive lipids comprise mono-glycerides, di-glycerides, triglycerides correlated to beneficial fatty acids like short and medium chains; conjugated linoleic acid (CLA), and polyunsaturated fatty acids (PUFAs). The minor lipid components such as phospholipids, are also carry biological and health promoting activities. **[14].**

Now, let us make a focus on each individual component:

By **Parody, (2004)** for butyric acid; milk fat is considered a unique and relatively rich source of butyrate which represents between 75 - 130 m mole/mole of FAs Moreover, butyric acid plays an important role in controlling cell growth, differentiation and preventing tumor genesis in colon cells **[14].**

On the other hand, Conjugated linoleic acid (CLA) belongs to a family of geometric and positional isomers of linoleic acid **[41].** The main precursor of CLA is linoleic acid as referenced by **[21]**. For the health benefits of CLA; as stated by **Abbas *et al.*** , **2014** and **Park and Wu (2014);** it has potential on the reduction of body fat, prevention of cancer & cardiovascular diseases, modulation of immune & inflammatory responses, and improvement of bone health.

On another scope; milk fat is a source of *iso* and *anteiso* fatty acids which are labeled as odd and branched-chain fatty acids (OBCFAs). Their numbers are 56 specific isomers and chain lengths varying from 4 to 26 carbon atoms **[22]**. Odd and branched-chain fatty acids in milk fat largely derive from rumen bacteria and divided into three main classes: evenchain *iso* acids, odd-chain *iso* acids, and odd-chain *anteiso* **[46]**. Likewise, there are seven major OBCFAs in food products submitted by **Ollberding, (2016)**, which include *iso*14:0, *iso*-15:0, *anteiso*-15:0, *iso*-16:0, *iso*-17:0, *anteiso*-17:0, and *iso*-18:0. The healthy benefits of OBCFAs were proved by little studies **[49].** outlined that both a*nteiso* and i*so* branch-chain fatty acids inhibited tumor outgrowth and the highest activity was observed with 16:0 iso. The odd and branched-chain fatty acids prevent fatty acid synthesis of tumor cells through direct effects on fatty acid syntheses and reductions in fatty acid precursor supply**.**

On another side, Milk-Fat-Globule-Membrane (MFGM) contains approximately 60– 70% of total PLs in milk which represented 0.5–1% of the total lipids in milk. The majority of milk lipids are sphingo-lipids and glycerol- phospholipids, which show polar properties as they are amphiphilic molecules with hydrophobic fatty acyl chains and a hydrophilic organophosphate (choline, serine, inositol or ethanolamine) head group [18]. Phospholipids (PLs) are mainly existed in milk fat globule membrane and in the membrane compounds of the skim milk. The properties of the raw materials and applied technological processes deeply affected in PLs content dairy products (Any treatment caused a perturbation of the membrane or a separation or fractionation of fat globules, influenced PLs composition and distribution in the final product **[4] and Abd Hamid *et al.* (2019)** From healthy views; phospholipids and their digestion products are considered as the most bioactive compounds. Sphingolipids have been implicated as modulators of physiologic and pathophysiologic processes such as inflammatory responses **[11]**. Moreover, sphingomyelin can influence cholesterol metabolism, coronary heart disease and associated with age- related diseases & the development of Alzheimer's diseases. Gangliosides exhibit anti-infection activity and may also protect against mucosal damage.

On contrary, *trans* fatty acids (TFAs) have negative health effect. **The U.S. Food and Drug Administration, (2003)** defined TFAs as "all unsaturated fatty acids that contain one or more isolated double bonds in *trans* configuration". Multiple researches have implicated that a high consumption of *trans* fatty acids may be a cause of cardiovascular disease (CVD) and coronary heart disease (CHD). Intake of TFAs should not exceed 1% of total energy as recommended by **World Health Organization, (2003)** to reduce CVD risk. Both **Mensink *et al.*, 2003** and **Mozaffarian *et al.*, 2006** reported that TFAs could raise low-density lipoprotein (LDL) cholesterol concentrations and plasma triglycerides in blood so it might be a cause of atherosclerosis, sudden cardiac death.

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Consequently, the main goal of this research was to make a focus on the bioactive lipids content in two types of Egyptian milk (buffalo & goat) during summer and winter seasons. Also, this research can be utilized nowadays for facing of various diseases prevalent, in recommendation to consume buffalo and goat milk as rich sources of bioactive lipid to prevent chronic diseases.

MATERIALS AND METHODS

MATERIALS

Raw milk

Buffalo raw milk was obtained from the Dairy department, Faculty of Agriculture, Cairo University ,while goat milk was obtained from the Gemmezah station, Animal Production Research Institute; Agricultural Research Center, Egypt. Milk samples were collected in winter season (November to January), and in summer season (May to July). Thirty two samples of individual buffalo milk and eighteen individual goat milk samples were collected. All samples were collected at morning milking.

All the previous individual samples were mixed to compose 3 and 4 composite samples for goat and buffalo milk, respectively. Each composite sample was cheeked for its main chemical composition. For summer season there were (16.70 & 10.20%) for total solids, (6.10 & 2.30 %) for fat, (3.80 & 2.06 %) for protein, and (0.85 & 0.73%) for ash of buffalo and goat milk respectively. Also, there were (18.25 & 12.83%), (7.07 & 3.26%), (4.25 & 2.90%) and (0.87 & 0.86%) in winter season for the same compositions and types of milk respectively.

Methods

Chemical composition of milk samples:

Gross chemical composition of all milk samples include total solids, fat, protein and ash contents were determined as mentioned by **AOAC, (2012)**.

Determination of total conjugated diene and triene contents:

Conjugated diene acids (CDA) and triene (CTA) were determined according to the modified version of the **AOAC, (2012)** and were calculated using the following equations:

$$\textbf{CDA (\%)} = \textbf{(0.84 x A) / (bc-K}_0\textbf{)}$$

$$\textbf{CTA (\%)} = \textbf{(0.84 x B) / (bc-K}_0\textbf{)}$$

Where:

A is the absorbance at 233 nm. **B** is the absorbance at 280 nm.

b is the length of cell (cm) **c** is gram / liter. $\mathbf{K_0}$ is the absorptivity by ester groups (0.07). **Extraction of lipids and phospholipids:**

The total lipids and phospholipids were extracted according to the methods originally described by **Bligh and Dyer, (1959)** and reported by **Abd El-Hamid *et al* (2019)**.

Determination of fatty acid profile:

Preparation of fatty acids methyl esters (FAME):

Fatty acids methyl esters were prepared according to the method of **Wirasnita *et al.* 2013.**

Determination of fatty acids by GC- MS apparatus:

Fatty acid profile was assessed using gas chromatography coupled with a mass spectrometer (Shimadzu GC-MS QP 2120, Shimadzu, Kyoto, Japan).

The exact structure of *iso* and *anteiso* isomers of fatty acids were confirmed also by isolation of M^+ ions for branched chain fatty acid methyl ester (BCFAME) for fragmentation in EIMS2 mode, according to **Ran-Ressler *et. al*, 2003.**

Preparation of phospholipid samples

The phospholipids were prepared according to the method mentioned by **Murgia *et al.*, (2003)**.

Determination of phospholipid classes by ^{31}P-NMR technique

High-resolution ^{31}P-NMR spectra, acquired at the NMR Service of Istituto di Chimica Biomolecolare del CNR (Pozzuoli, Italy), were obtained at 27°C on a Bruker Avance-400 operating at 161.97 MHz, using an inverse probe fitted with a gradient along the Z-axis. The ^{1}Hdecoupled, one-dimensional ^{31}P spectra were obtained using the following conditions: spectral width 200 ppm, delay time 7 s, pulse width of 8.0 µs (60° spin-flip angle), number of scans 3000, number of data points 32 K. Phospholipids samples contained 10% dimetylformamide-d7 for internal lock, and internal phosphatidylcholine was used as reference. Sphingomyelin from chicken egg yolk, rac-1,2-dipalmitoyl-glycero-3-phosphoethanolamine; (phosphatidylethanolamine); 1,2-dipalmitoyl-sn-glycero-3-phosphocoline (phosphatideylcholine); 3-sn-phosphstidyl-L-serine from bovine brain (phosphatidylserine); sn- glycerol-3-phosphate (phosphatidylglycerol) and phosphatidylinositol sodium salt from soybean were used as standards for phospholipids assignment.

Statistical Analysis:

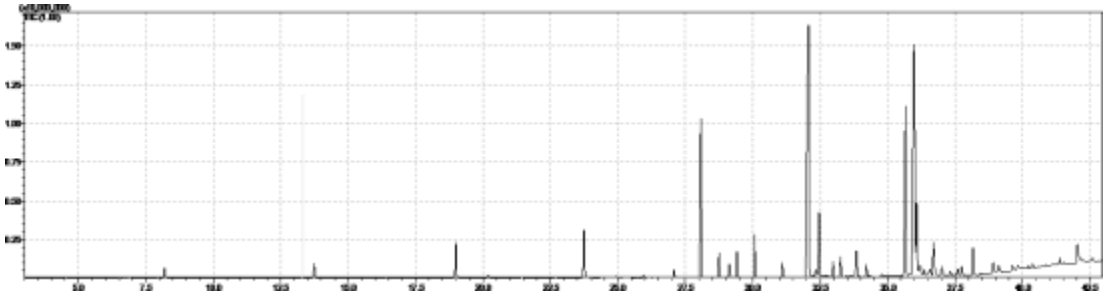
Statistical analysis for obtained data was carried out using analysis of variance (ANOVA) and Duncan tests with the Statistical Analysis System **(SAS, 2004).** A probability of $P < 0.05$ was used to establish the statistical significance.

RESULTS AND DISCUSSION

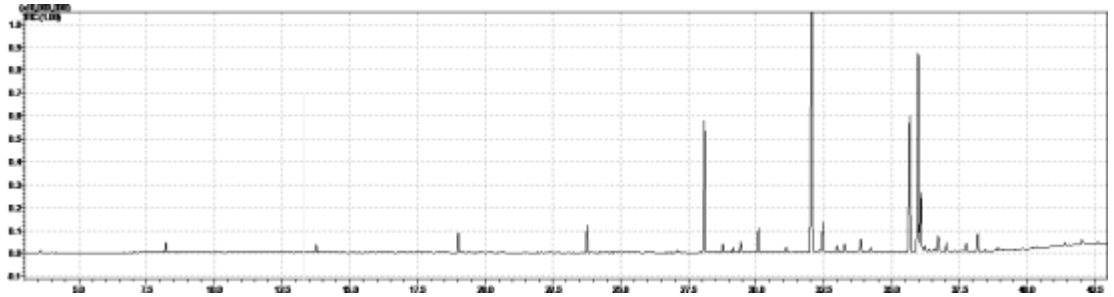
Fatty acids profiles of buffalo and goat milk during summer and winter seasons:

The content of the different bioactive lipids in buffalo and goat milk during summer and winter seasons had been illustrated in **Fig. 1. (a,b,c,d)**. The data were calculated and expressed in the following tables.

Buffalo and goat milk during summer season (a &b)



(a)



(b)

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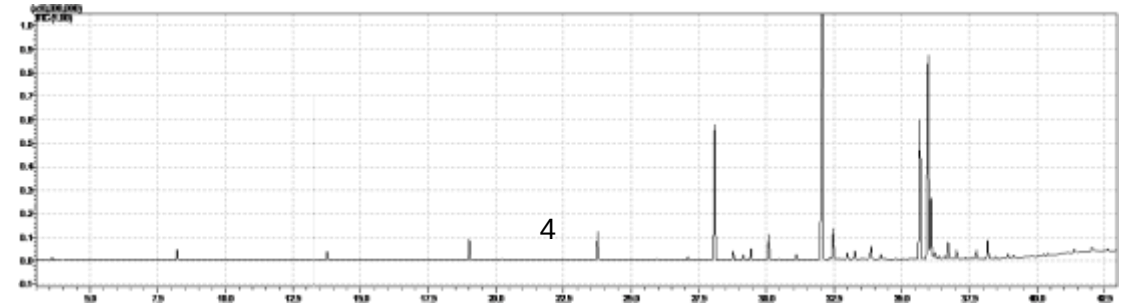
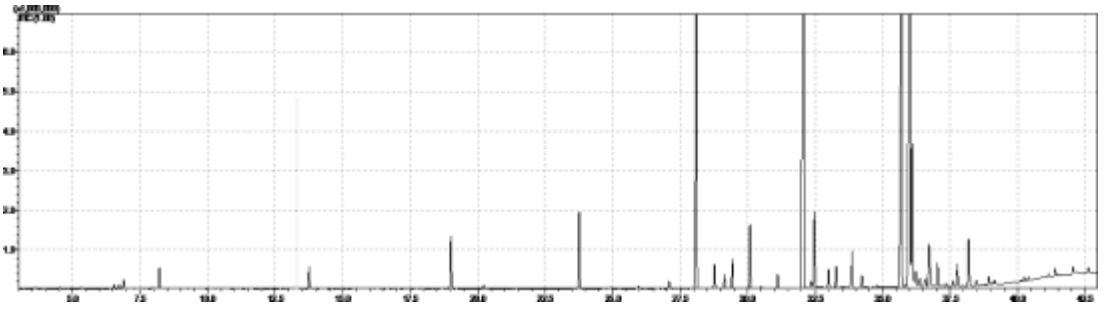
Buffalo and goat milk during winter season (c &d)



(c)



(d)

Fig. (1): GC/MS chromatograms of buffalo and goat milk during summer and winter seasons.

a: **Buffalo milk sample during summer season b**: **Goat milk sample during summer season c**: **Buffalo milk sample during winter season d**: **Goat milk sample during winter season.**

The individual bioactive lipids contents:

1- Butyric acid and short chain fatty acids:

Butyric acid and short chain fatty acids (SCFAs) contents of buffalo and goat milk samples during summer and winter seasons were presented in Table (1). It was demonstrated that there were significant differences ($p \leq 0.05$) between buffalo and goat milk in all SCFAs contents. The average values of butyric, caproic, caprilyic and capric acids were 2.54, 0.50, 0.66 and 1.55% for buffalo milk, while they were 2.04, 1.66, 1.94 and 6.30% for goat milk during summer season, respectively. On the same side, the corresponding values of buffalo milk during winter season were 2.97, 0.77, 0.70 and 1.70% whilst for goat milk were 2.26, 1.96, 2.23 and 7.68% of total FAs, in the same order.

Table (1): Butyric and short chain fatty acids contents (as % of total fatty acids) of buffalo and goat milk samples during summer and winter seasons.

Fatty Acids	Summer		Winter	
	Buffalo	Goat	Buffalo	Goat
C4:0 (Butyric)	2.54^{b}± 0.12	2.04^{d}± 0.04	2.97^{a}±0.1 3	2.26^{c}±0.07
C6:0 (Caproic)	0.50^{d}± 0.04	1.66^{b} ± 0.02	0.77^{c}±0.1 0	1.96^{a}±0.06
C8:0 (Caprilyic)	0.66^{c}± 0.07	1.94^{b} ± 0.01	0.70^{c}±0.0 6	2.23^{a}±0.16
C10:0 (Capric)	1.55^{c}± 0.06	6.30^{b}± 0.01	1.70^{c}±0.1 1	7.68^{a}±0.43

Results are presented as means ± standard deviation (SD). Means with the same letter are not significantly different ($P \leq 0.05$)

From these data, it could be noticed that, Egyptian goat milk was characterized by significant higher level of short chain fatty acids, except butyric acid, while buffalo one was characterized by the lower content of SCFAs except butyric acid. On the same side, **Talpur *et al*., (2007),** reported that butyric acid content of Pakistani-Water-Buffalo Kundi and Nili-Ravi breeds were 3.72 and 4.20 g/100g fat, respectively. While, **Abbas *et al*. (2014a)** mentioned that butyric acid for Egyptian goat milk varied between 2.3-3 g/100g fat.

2-Total conjugated diene (CDA) and triene (CTA) fatty acids:

Conjugated diene and triene fatty acids contents of buffalo and goat milk during summer and winter seasons had been demonstrated. Their contents between both types of milk had great significant differences ($p \leq 0.05$). Egyptian Buffalo milk had higher conjugated diene acids (CDA) content (0.7868%) during summer than goat milk (0.5506%). As well, buffalo milk contained higher value of CDA (0.8630%) during winter season as compared to goat milk (0.7010%). The same trend was realized for conjugated triene acids (CTA); there values were 0.2226 and 0.1549% for buffalo and goat milk during summer season, while they were 0.2261 and 0.1630% for buffalo and goat milk during winter season, respectively. These data were in harmony with the results of **Park *et al*., (2007)** and **Bharwadeet e*t al*. (2017)**.

3--Conjugated linoleic acid and its isomers:

Conjugated linoleic acid and its isomers contents of buffalo and goat milk during summer and winter seasons were exhibited in Table (2). As shown from the Table; non-significant differences ($p \geq 0.05$) were observed between Egyptian buffalo and goat milk during summer and winter seasons in conjugated linoleic acid and its isomers contents (except trans-10, cis-12 and trans-9, trans-11 contents during winter season) . It could be recognized that CLA (cis-9, trans-11) content was 0.29 and 0.33% whilst cis-10, cis-12 was 0.11 and 0.15% of total FAs for buffalo and goat milk during summer season, respectively. The identical values of buffalo milk during winter season were 0.43 and 0.16%, while they were 0.51 and 0.17% of total FAs for goat milk, in order. The average values of trans-10, cis12 and trans-9, trans-11 were 0.01 and 0.02% for buffalo milk during summer season versus 0.08 and 0.06% for goat milk whilst they were 0.04 and 0.03% in buffalo milk during winter season versus 0.20 and 0.12% of total FAs in goat milk, in the same order., **Gonzalez *et al*. (2017)** were confirming present data.

Table (2): Conjugated linoleic acid and its isomers contents (as % of total fatty acids) of buffalo and goat milk samples during summer and winter seasons.

Fatty acids	Summer		Winter	
	Buffalo	Goat	Buffalo	Goat
***Cis9 trans11*C18:2**	0.29^{b} ±0.0 4	0.33^{b}±0.07	0.43^{a}±0.07	0.51^{a}±0.03
***Cis10 cis12*C18:2**	0.11^{b} ±0.0 2	0.15^{b}±0.01	0.16^{a}±0.09	0.17^{a}±0.02
***Trans10 cis12*C18:2**	0.01^{b}±0.0 2	0.08^{b}±0.07	0.04^{b}±0.03	0.20^{a}±0.09
***Trans9 trans11*C18:2**	0.02^{b} ±0.0 1	0.06^{b}±0.03	0.03^{b}±0.01	0.12^{a}±0.06

Results are presented as means ± standard deviation (SD). Means with the same letter are not significantly different ($P \leq 0.05$).

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4- Odd and branched chain fatty acids (OBCFAs):

Odd and branched chain fatty acids contents of buffalo and goat milk during summer and winter seasons represented in Table (3). Noticeably; there were significant differences in the results of total OBCFAs contents of buffalo and goat milk; where their average values of buffalo and goat milk were 10.05 and 7.85 % during summer season whilst they were 6.90 and 10.0 % during winter season, respectively. From the same table, it is noticed that C15:0 was the most abundant in both types of milk followed by C17:0, C17:0 *iso* and C14:0 *anteiso*. Their average values were 2.24, 1.79, 1.03 and 1.30% for buffalo milk during summer season versus 1.25, 1.48, 1.32 and 0.80% for goat milk, while in buffalo milk during winter season were 1.84, 1.22, 0.69 and 0.84 % versus 2.02, 1.87, 0.92 and 1.14% of total FAs for goat milk, in the same order. Same line was observed by **Devle *et al.*, (2012)** and **Teng *et al.*, (2017**).

Table (3): Odd and branched chain fatty acids contents (as % of total fatty acids) of buffalo and goat milk samples during summer and winter seasons.

Fatty Acids	Summer		Winter	
	Buffalo	Goat	Buffalo	Goat
C11:0	0.03^{ab}±0.01	0.05^{a}±0.03	0.02^{b}±0.01	0.04^{ab}±0.01
C12:0 *iso*	0.04^{a}±0.008	0.03^{a}±0.005	0.08^{b}±0.02	0.02^{a}±0.07
C12:0 *anteiso*	0.06^{b}±0.008	0.02^{a}±0.005	0.03^{a}±0.008	0.05^{ab}±0.02
C13:0	0.13^{a}±0.005	0.09^{b}±0.03	0.07^{c}±0.009	0.12^{ab}±0.01
C13:0 *iso*	0.40^{a}±0.03	0.18^{c}±0.01	0.23^{cb}±0.009	0.30^{b}±0.05
C14:0 anteiso	1.30^{a}±0.06	0.80^{c}±0.07	0.84^{c}±0.08	1.14^{b}±0.03
C14:0 iso	0.72^{a}±0.04	0.54^{c}±0.001	0.41^{c}±0.03	0.60^{b}±0.05
C15:0	2.24^{a}±0.02	1.25^{c}±0.48	1.84^{b}±0.20	2.02^{ab}±0.05
Cis9-C15:1	0.03^{a}±0.01	0.04^{a}±0.01	0.03^{a}±0.01	0.04^{a}±0.01
Cis11-C15:1	0.03^{b}±0.01	0.16^{a}±0.003	0.06^{b}±0.02	0.14^{a}±0.02
C18:0 iso	0.16^{a}±0.01	0.14^{b}±0.01	0.08^{c}±0.01	0.13^{b}±0.02
C18:0 anteiso	0.56^{a}±0.03	0.51^{a}±0.02	0.23^{c}±0.03	0.33^{b}±0.04
C16:0 iso	0.78^{a}±0.05	0.48^{c}±0.07	0.41^{d}±0.03	0.64^{b}±0.04
C17:0	1.79^{a}±0 .16	1.48^{b}±0.04	1.22^{c}±0.11	1.87^{a}±0.07
Cis9-C17:1	0.72^{a}±0 .04	0.65^{ab}±0.02	0.50^{b}±0.15	0.60^{ab}±0.05
C17:0 iso	1.03^{b}±0.03	1.32^{a}±0.18	0.69^{c}±0.06	0.92^{b}±0.04
C17:0 anteiso	0.03^{c}±0 .01	0.09^{b}±0.04	0.05^{cb}±0.008	1.04^{a}±0.05
Total	10.05^{a}±0.02	7.85^{c}±0.01	6.90^{d}±0.01	10.0^{b}±0.03

Results are presented as means ± standard deviation (SD). Means with the same letter are not significantly different ($P \leq 0.05$).

***5 -Trans* fatty acids:**

On the other hand, *Trans* fatty acids contents of buffalo and goat milk during summer and winter seasons were depicted in Table (4). It was conducted that goat milk gained higher contents of $trans_9$-C16:1, $trans_{11}$-C18:1 and $trans_{11}$-C20:1 during both summer and winter seasons than buffalo milk. Their average values were 0.51, 1.48 and 0.09% for goat milk during summer season versus 0.36, 0.77 and 0.07% for buffalo milk, while they were 0.22, 2.06 and 0.14% for goat milk during winter season versus 0.16, 1.09 and 0.07% of total FAs for buffalo milk, respectively. Furthermore, buffalo milk contained higher proportion of $trans_9$-C18:1 than goat milk during both summer and winter seasons. The average value of $trans_9$-C18:1 was 3.04% in buffalo milk during summer season versus 2.06% for goat milk whilst it was 3.83% for buffalo milk during winter season versus 3.08% of total FAs for goat milk, in the same order. **Alonso *et al.* (1999)** and, **Talpur *et al.*, (2008)** supported these results.

Table (4): *Trans* fatty acids contents (as % of total fatty acids) of buffalo and goat milk during summer and winter seasons.

Fatty acids	Summer		Winter	
	Buffalo	Goat	Buffalo	Goat
***Trans*$_9$-C16:1**	0.36^{b}±0.0 4	0.51^{a}±0.03	0.16^{d}±0.01	0.22^{c}±0.06
***Trans*$_9$-C18:1**	3.04^{b}±0.79	2.06^{c}±0.07	3.83^{a}±0.24	3.08^{b}±0.24
***Trans*$_{11}$-C18:1**	0.77^{d}±0.0 4	1.48^{c}±0.03	1.09^{b}±0.04	2.06^{a}±0.03
***Trans*$_{11}$-C20:1**	0.07^{a}±0.0 4	0.09^{a}±0.04	0.07^{a}±0.01	0.14^{a}±0.05

Results are presented as means ± standard deviation (SD). Means with the same letter are not significantly different ($P \leq 0.05$).

6- Total polar lipids (PLs) contents:

Total polar lipids (PLs) content of Egyptian buffalo and goat milk in summer and winter seasons were illustrated in **Fig. (2)**. There were significant differences in PLs content of samples during summer and winter seasons. Buffalo milk had higher PLs content in both summer and winter seasons than goat milk. Their average values were 0.27 and 0.33 g/100g fat for buffalo milk, while they were 0.20 and 0.26 g/100g fat for goat milk during summer and winter seasons, respectively. Same trend was early observed by some researchers. These results are in harmony of **Hofi *et al.* (1977) and Asker *et al.* (1978).**

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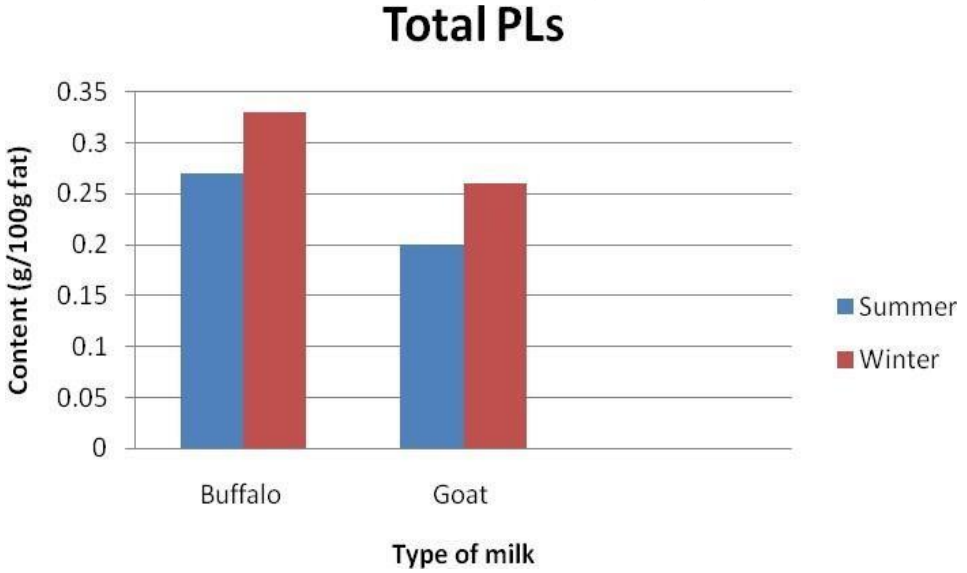

Fig. (2): Total polar lipids contents (g/100g fat) of buffalo and goat milk samples during summer and winter seasons.

7- Phospholipids classes

Phospholipids classes content of Egyptian buffalo and goat milk during summer and winter seasons were presented in Table (5). As shown from this table; significant differences in the values of phospholipids classes were recognized between both types of milk during summer and winter seasons. Goat milk had higher contents of Phosphatidylcholine (PC), phosphatidylethanolamine (PE), sphingomyelin (SM) and phosphatidylglycerol (PG) than buffalo milk during summer and winter seasons. Their average values were 23.4, 24.9, 26.1 and 11.4% for goat milk during summer season versus 19.5, 22.3, 23.3 and 8.8% for buffalo milk .Whilst they were 24.3, 25.9, 27.1 and 8.6% for goat milk during winter season versus 20.9, 23.2, 24.0 and 5.9% of total PLs for buffalo milk, in the same order. Conversely, buffalo milk had higher content of phosphatidylserine (PS) and phosphatidylinositol (PI) than goat milk during both seasons. Their average values were 9.0 and 16.9% for buffalo milk during summer season versus 7.8 and 6.6% for goat milk. While they were 8.8 and 17.2% for buffalo milk during winter season versus 7.5 and 6.5% of total PLs for goat milk, respectively.

It was known that PE is a zwitter-ionic-phospholipid mainly located in the internal layer of the MFGM and considered the most unsaturated class but PI is considered an anionicphospholipid mostly found in the internal layer too of the MFGM. **[12]**. PE-concentration influences the phase behavior of PLs mixtures, transforming to a reversed hexagonal phase instead of a lamellar phase at higher concentrations **[47]** Phosphatidylcholine (PC); is one of little substances able to penetrate into blood-brain barrier in the body, going directly into the brain cells where it is used for producing acetylcholine (ACh), that may act as a neurotransmitter for memory enhancement **[40, 27]**.

In [27] the authors illustrated that exogenous PC was participate in anti- inflammatory signaling networks and exerted an immune-modulatory effect. Moreover, exogenous PC intake could enhance intestinal barrier defense by inhibiting pro-inflammatory cytokine production**[33].**

Table (5): Phospholipids classes' content (as % of total phospholipids) of buffalo and goat milk samples during summer and winter seasons.

Classes	Summer		Winter	
	Buffalo	**Goat**	**Buffalo**	**Goat**
PC	19.5^{c}±0.98	23.4^{a}±0.56	20.9^{b}±0.67	24.3^{a}±0.20
PE	22.3^{a}±0.33	24.9^{b}±0.21	23.2^{c}±0.29	25.9^{a}±0.25
PS	9.0^{a}±0.38	7.8^{b}±0.21	8.8^{a}±0.49	7.5^{b}±0.10
SM	23.3^{b}±0.29	26.1^{c}±0.21	24.0^{a}±0.21	27.1^{b}±0.20
PI	16.9^{a}±0.21	6.6^{b}±0.42	17.2^{a}±0.25	6.5^{b}±0.26
PG	8.8^{b}±0.80	11.4^{a}±0.42	5.9^{c}±0.59	8.6^{a}±0.90

PC= Phosphatidylcholine; PE= phosphatidylethanolamine; PS= phosphatidylserine; SM= sphingomyelin; PI= phosphatidylinositol; PG= phosphatidylglycerol. Results are presented as means ± standard deviation (SD). Means with the same letter are not significantly different ($P \leq 0.05$).

Sphingomyelin is found in high quantities in the brain and neural tissues, and phosphatidylcholine is the major dietary source of choline (a precursor of acetylcholine synthesis) and also plays a vital role in neuronal membranes **[31]**. On the other side, **in [11]** the authors manifested that PL intake improved both of post-stress reaction time performance on an attention-switching task and mid-stress induction energetic arousal. So, they proved that man can increase his cognitive performance advantages dietary when supplementing with bovine milk PLs under conditions of psychosocial stress.

CONCLUSION AND RECOMMENDATIONS:

Both Egyptian buffalo and goat milk are rich sources of bioactive lipids which consider as good compounds for human health. The differences between the bioactive lipids contents of both buffalo and goat milk are due to the species and feeding system. Results of the present research indicated that winter milk contained higher contents of the studiedbioactive lipids than summer milk, where the green fodder is in winter. Data displayed that goat milk is rich source of conjugated linoleic acid (CLA); sphingomyelin (SM) and Phosphatidylcholine (PC) than buffalo milk. Thus, it could be recommended that the consumption or diet supplementation with goat milk is benefit for memory improvement, mental health especially for cognitive performance and Alzheimer and as anti-inflammatory agent.

It also can be advice that the intake of conjugated linoleic acid- enriched diet reduced body weight and normalize glucose levels in diabetes patients At the same time, buffalo milk had higher contents of butyric acid, conjugated diene & triene fatty acids and oddbranched chain fatty acids .It could be recommended that the buffalo milk can be consumed as a source OBCFAs which have potential effect against cancer.

Further studies are required to investigate the influence of some bioactive lipid classes on biological activities of human body to employ these characteristics to treat special patient's conditions. More information about these bioactive lipids advantages must be achieved in multiple researches in the near future.

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