PROCEEEDINGS OF INTERNATIONAL BIOLOGICAL, AGRICULTURAL AND LIFE SCIENCE CONGRESS

NOVEMBER 7-8, 2019

LVIV, UKRAIN

PROCEEEDINGS OF INTERNATIONAL BIOLOGICAL, AGRICULTURAL AND LIFE SCIENCE CONGRESS

7-8 NOVEMBER, 2019,

LVIV, UKRAIN

In

Lviv, Ukrain

Organized by

Trakya University

ISBN # : 978-975-374-249-8

Trakya University Publisher No: 220

WELCOME NOTES

You are welcome to our BIALIC Congress that is organized by Trakya University. The aim of our conference is to present scientific subjects of a broad interest to the scientific community, by providing an opportunity to present their work as oral or poster presentations that can be of great value for global science arena. Our goal is to bring three communities, namely science, research and private investment together in a friendly environment of Lviv, Ukraine in order to share their interests and ideas and to benefit from the interaction with each other.

In November 2019, it will be held the first edition of the BIALIC Congress, with ambition of the organizers to make it a periodical event. We are proud to announce that in the BIALIC 2019 will take part more than 300 scientists and researchers from all over the world. There were submitted 376 scientific papers, of which 226 will be presented as oral talks and 150 as poster presentations. The full author list of all submitted papers comprises 936.

Our conference is a premier international science, technology and business forum focusing on Agriculture, Biology and Life Science. The technical sessions highlight invited and volunteer speakers. We love our nature and care about the environment. We wanted to make our conference as much greener as possible, using less paper. The participants' posters were submitted via conference web page and will be presented on electronic poster screens, developed particularly for this purpose. Abstract book is published in electronic version in bluetooth in the web which will be provided on each participant.

Conference Topics:

Agriculture, Forestry, Life Sciences, Agricultural Engineering, Aquaculture and Biosystems, Animal Science, Biomedical science, Biochemistry and Molecular Biology, Biology, Bioengineering, Biomaterials, Biomechanics, Biophysics, Bioscience, Biotechnology, Botany, Chemistry, Chemical Engineering, Earth Sciences, Environmental Science, Food Science, Genetics and Human Genetics, Medical Science, Machinery, Pharmaceutical Sciences, Physics, Soil Science.

Lviv is not only a very nice, lovely and historical city at the edge of Europe, but located just at the heart of Eastern Europe region. We are much pleased to host all of you in Lviv, Ukraine.

We would like to thank all of you for joining this conference and we would like to give also special thanks to our sponsors and collaborators for giving us a big support to organize this event.

We wish you nice stay in Lviv!

Prof Dr Yalcin KAYA

Head of the Organizing Committee

ORGANIZING COMMITTEE

Prof. Dr. Yalcin KAYA	Trakya University, Turkey	Chair
Assoc. Prof. Dr. Semra HASANCEBI	Trakya University, Turkey	Co-Chair
Asst. Prof. Dr. Necmi BESER	Trakya University, Turkey	Co-Chair
Prof. Dr. Yaroslav BLUME	Director of Institute of Food Biotechnology and Genomics, National Academy of Sciences of Ukraine	Member
Prof. Dr. Loannis TOKATLIDIS	Trakia Democritus University, Greece	Member
Dr. Leanordo VELASCO	CSIC, Sevilla, Spain	Member
Prof. Dr. Maria DUCA	University of National Academy of Sci. Moldova	Member
Assoc.Prof.Dr. Nooduan MUANGSAN	Suranaree University of Technology, Thailand	Member
Assoc. Prof. Dr. Gokhan KACAR	Trakya University, Turkey	Member
Assoc. Prof. Dr. Guzin Tunca	Trakya University, Turkey	Member
Asst. Prof. Dr. Mehmet YABAS	Trakya University, Turkey	Member
Assoc Prof. Dr. Suleyman KOK	Trakya University, Turkey	Member
Asst.Prof.Dr. Orhan Onur ASKIN	Kırklareli University, Turkey	Member
Emrah AKPINAR	Trakya University, Turkey	Secreatary

SCIENTIFIC COMMITTEE

NAME	INSTITUTION-COUNTRY
Acad. Prof. Dr. Atanas ATANASSOV	Joint Genomic Center- Sofia Bulgaria
Prof. Dr. Teodora POPOVA	Institute of Animal Science- Kostinbrod Bulgaria
Prof. Dr. Viliana VASSILEVA	Institute of Pleven Bulgaria
Prof. Dr Zhao JUN	Inner Mongolia Agricultural University China
Prof. Dr. Ioannis TOKATLIDIS	Trakia Democritus University Greece
Prof. Dr. Rishi K BEHL	CCS Haryana Agricultural University India
Prof. Dr Mohamed RAMDANI	University of Mohamed V Agdal Maroc
Prof. Dr Maria DUCA	University of National Academy of Sci Moldova
Prof Dr Velibor SPALEVIC	University of Montenegro Montenegro
Prof. Dr. Saeed RAUF	Muhammad Nawaz Sharief Agric Univ Pakistan
Prof. Dr. Dejana PANKOVIC	Educon University Serbia
Prof. Dr. Bulent UZUN	Akdeniz University Turkey
Prof. Dr. Nedim MUTLU	Akdeniz University Turkey
Prof. Dr. Ahmet ULUDAG	Onsekizmart University Turkey
Prof. Dr. Hulya ILBI	Ege University Turkey
Prof. Dr. Doganay TOLUNAY	Forestry Faculty, Istanbul University Turkey
Prof. Dr. Ahu ALTINKUT UNCUOGLU	Marmara University Turkey
Prof. Dr. Metin TUNA	Namık Kemal Universit Turkey
Prof. Dr. Sezen ARAT	Namık Kemal Universit Turkey
Prof. Dr. Mehmet Emin CALISKAN	Omer Halisdemir University Turkey
Prof. Dr. Murat YURTCAN	Trakya University Turkey
Prof. Dr. Fatma GUNES	Trakya University Turkey

EDITORS OF THE PROCEEDING BOOK

Prof Dr Yalcin KAYA

Content

HEALTH BENEFITS OF CONJUGATED LINOLEIC ACID

Mila ARAPCHESKA[1], Jovanka TUTESKA[2], Zehra HAJRULAI-MUSLIU[3], Risto UZUNOV[3]*

[1]*University "St. Kliment Ohridski", Faculty of Biotechnical Sciences - Bitola, Republic of North Macedonia*
[2]*University "St. Kliment Ohridski", High Medical School, - Bitola, Republic of North Macedonia*
[3]*University "Ss. Cyril and Methodius", Faculty of Veterinary Medicine – Skopje, Republic of North Macedonia*

*arapceska@yahoo.com

ABSTRACT

In recent years, the bioactive compounds present in food, even though in minor amounts, have received increased attention because they may have an important nutritional role.
Conjugated linoleic acid (CLA) is a generic term used to describe a group of geometric and positional isomers of linoleic acid with a conjugated double bond mainly at carbons 9 and 11 or 10 and 12. Milk fat is the richest natural source of CLA. The CLA-isomers are produced via biohydrogenation of the unsaturated fatty acids presented in animal feed into saturated by rumen bacteria and by the enzymatic activity of the *Δ9*-desaturase in the mammary gland.
Numerous physiological properties have been attributed to CLA including action as an antiadipogenic, antidiabetogenic, anticarcinogenic, antiatherosclerotic agent and chronic inflammatory diseases. In addition, CLA has effects on bone formation and the immune system as well as fatty acid and lipid metabolism and gene expression in numerous tissues.
Because potential health benefits have been associated with dietary consumption of CLA, enhancement of CLA concentrations in meat and milk is an important objective in nutrition research.

Key words: milk fatty acids; CLA; human health

INTRODUCTION

There is increasing evidence that nutrition plays an important role in the development of human chronic diseases including cancer, cardiovascular disease, insulin resistance and obesity. Development of foods and diets that promote human health play a central role to public health initiatives for preventing and lowering the economic and social impact of chronic disease (Shingfield and Wallace 2014).

In recent years there is increased interest about foods which contain components that have bioactivity. Milk and dairy products have long traditions in human nutrition (Miller et al., 2007; Rogelj, 2000).

Milk composition is rather than complex. Its components are subject of research for many years. Milk alone is much more than the sum of its nutrients. It is composed of various substances with bioactive properties and therefore milk was given an epithet of functional food. Not only nutritional value but also other physiological properties of milk components are subject of interest (Miller et al., 2000).

The most variable component of milk is milk fat. It is one of the components which determine milk nutritive quality and technological performance of milk.

Mainly milk fat is composed of triglycerides, approximately 98%, while other milk lipids are less present (diacylglycerols about 2%, cholesterol less than 0.5%, phospholipids about 1% and free fatty acids FFA about 0.1%) (Jensen et al., 1991, MecGibbon and Taylor, 2006). According saturation of fatty acids, bovine milk fat contains 70-75% saturated fatty acids, 20-25% monounsaturated fatty acids, and 2-5 % polyunsaturated fatty acids. Profile of fatty acids present in milk fat determines uniqueness of its composition as well as its physiological characteristics (Chilliard et al., 2003). Despite the high content of saturated fatty acids milk fat contains a number of components with health beneficial properties.

Bioactive components of milk fat

Milk fat is composed of components which are needed for normal performing of physiological functions of human It contains a number of components which are metabolically active such as: sphingolipids, conjugated linoleic acid isomers (CLA), butyric acid, other fatty acids, vitamins A and D. A variety of health benefits have been associated with these compounds.

Bovine milk fat represents a rich source of biologically active molecules, many of which offer potential for commercial exploitation in health-promoting functional food products.

A variety of health benefits have been associated with sphingolipids and their digestion products, ceramides and sphingosines. They are suggested to be important in prevention from carcinogenesis, reduction of serum LDL cholesterol, regulation of the immune system and inhibition of foodborne pathogens.

CLA isomers which are naturally occurring fatty acids found in animal fats, exhibit a number of health benefits. CLA are found in relatively large quantities in the milk and/or meat of ruminant animals and appears to be metabolized differently than linoleic acid. In the diet of many consumers, meat and dairy products would be a significant source of CLA (Barbosa et al. 2003).

Butyric acid has been suggested to have an anti-tumor role and it is especially effective in colon cancer prevention. Vitamin A and D and ß-carotene are also offered as natural anti-carcinogens in numerous reviews. As health benefits of these bioactive components of milk fat has been studied mostly in vitro conditions, in vivo researches are not sufficient. So, further research is required to establish the contribution of these dietary components to host metabolism and health (Alkalin et al., 2006).

Biosynthesis of CLA

CLA refers to a mixture of 28 positional and geometric isomers of linoleic acid ($C_{18:2}$, *cis-9, cis-12*) with two conjugated double bonds at various carbon position in the fatty chain. Each double bond can be *cis* or *trans* configuration giving rise to possible CLA isomers (conjugated diene) that can occur in a *cis-trans, trans-cis, cis-cis* or *trans-trans* geometrical configuration with double bond at positions 8 and 10, 9 and 11, 10 and 12 or 11 and 13.

The most abundant isomer in food products from ruminants is *cis-9, trans-11* $C_{18:2}$ (rumenic acid) comprising 80-90% of the total CLA isomers, whereas *cis-12, trans-10* $C_{18:2}$ is present in smaller amounts, 3-5%. Both isomers have been proven to have biological activities. The content of rumenic acid and other CLA isomers of most foods are somewhat variable due to differences mainly in environmental conditions and diet of the originating animal species. The major sources of naturally occurring CLA isomers are foods containing ruminant fat. Milk and dairy products have been shown to contain the highest amounts of CLA isomers (McGuire and McGuire., 1999).

The natural occurring CLA isomers in milk are formed using two different pathways (Fig.1 and Fig.2). First, CLA is formed during ruminal biohydrogenation of PUFA from dietary lipids and the second CLA is synthesized by animal tissues from *trans*-11 $C_{18:1}$ (vaccenic acid; VA), another intermediate in the biohydrogenation of unsaturated fatty acids (Bauman et al., 2003).

In first pathway, reactions proceed via different mechanisms catalyzed by bacterial enzymes. In the rumen, dietary lipids are rapidly hydrolyzed, and the resulting unsaturated free fatty acids can undergo biohydrogenation via the rumen microorganisms. However, when biohydrogenation is incomplete, various CLA as intermediates of this pathway can escape the rumen and can be absorbed through the gastrointestinal tract, thereby providing the peripheral tissues with various isomers of CLA (Harfoot and Hazelwood, 1988).

Another way of forming of rumenic acid in milk is endogenous conversion of *trans*-11 $C_{18:1}$ (vaccenic acid; VA) by enzyme delta-9 desaturase in the mammary gland (Bauman et al., 2003; Bauman and Lock, 2010; Griinari et al., 2000).

The rumen bacteria involved in biohydrogenation have been classified into two groups, A and B, based on their metabolic pathways. To obtain complete biohydrogenation of polyunsaturated fatty acids (PUFA), bacteria from both groups are generally required (Bauman et al., 2003). Two key biohydrogenation intermediates are: *trans*-11 $C_{18:1}$ (vaccenic acid; VA) formed from linoleic and linolenic acids and *cis*-9, *trans*-11 $C_{18:2}$ (rumenic acid) formed from biohydrogenation of linoleic acid. These intermediates are present in appreciable quantities in ruminant fat at a ratio of about 3:1 (Bauman et al., 2003; Bauman and Lock, 2010).

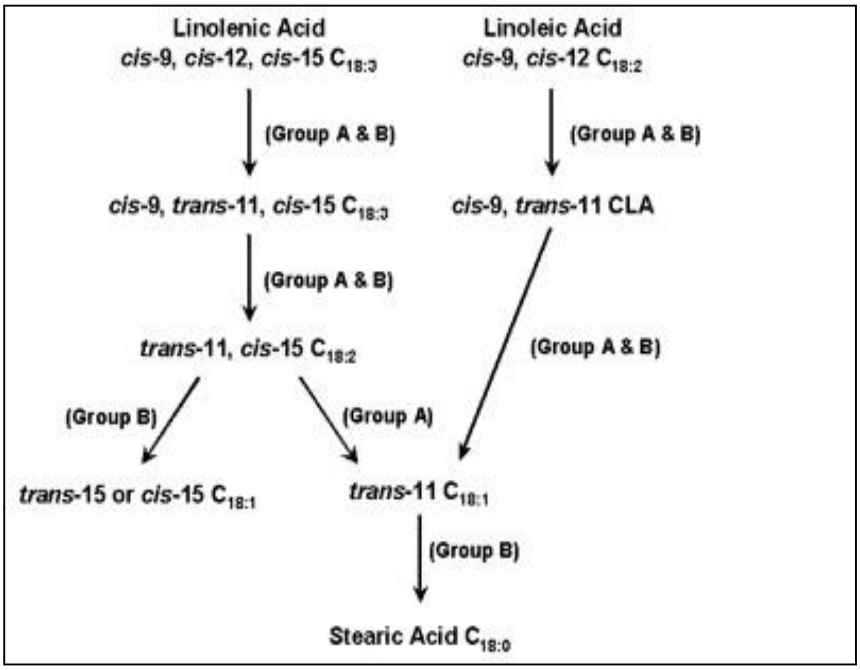

Figure 1: Pathway of biohydrogenation of linoleic and α-linolenic acids to stearic acid by rumen microorganisms (Bauman et al., 2003)

In the rumen *cis*-9, *trans*-11 CLA is only a transitory intermediate. The most of the *cis*-9, *trans*-11 CLA found in ruminant fat originates in the mammary gland and adipose tissue from endogenous synthesis involving desaturation of the *trans*-11 $C_{18:1}$, rumen-derived VA as a substrate by enzyme delta-9 desaturase (Fig. 2).

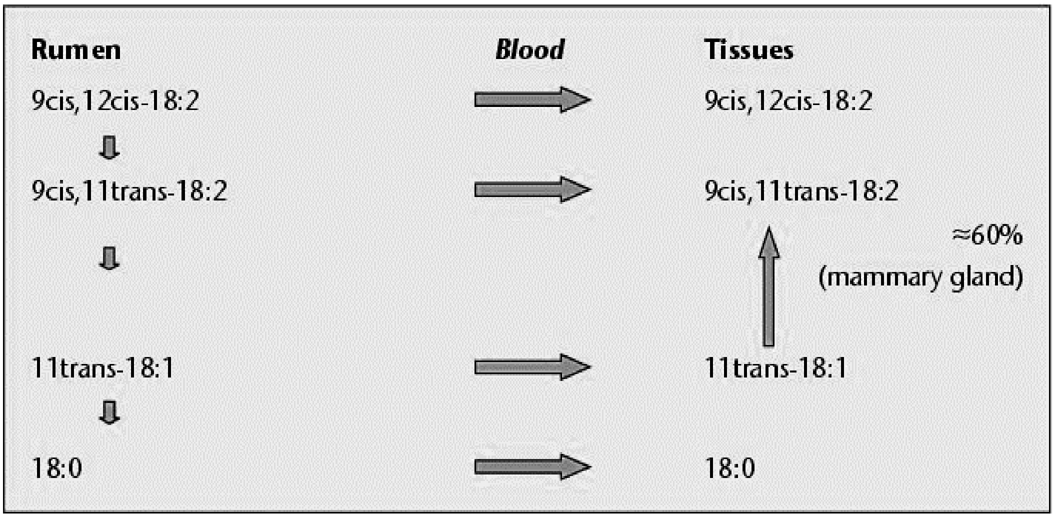

Figure 2: Metabolic pathways involved in the biosynthesis of CLA in ruminants (*Griinari et al., 2000*)

Various factors are known to influence the CLA content in milk, such as the food of the ruminant, the season, the animal breeding type, the number of times the animal has lactated and the current stage of lactation (Sebedio et al., 1999).

Regarding the potential benefits of CLA for human health, a number of research studies are oriented toward finding the possible ways of increasing the CLA concentration in milk fat. The first approach to achieve this objective is to use dietary modification in an attempt to increase the natural production of CLA in the dairy animals. The second approach include the synthetic mixture of CLA isomers in animal feed, protected in some way from the microbial biohydrogenation in the rumen (Silva et al 2014).

Health benefits of CLA

Research conducted in recent years suggests many health benefits leading from the consumption of CLA. Milk fat and meat of ruminants are the richest natural dietary source of CLA. Reported beneficial health-related effects of CLA include anti-carcinogenic effect in many cell culture and animal models. It also has positive effects on cell growth, it has immune modulating properties and improves the function of the immune system. It has anti-atherogenic and anti-diabetic effect and may improve glucose tolerance. Hence CLA is considered as functional food.

Most of the research on CLA is associated with its anti-carcinogenic properties. Inhibitory effects of CLA against carcinogenesis have been demonstrated in a variety of cell type, sites, and animal models including mammary gland, skin, colon, prostate, and forestomach of rats, humans, mice, and hamsters. In contrast to the hundreds of phytochemicals possessing varying degrees of anticancer properties, CLA is unique in that it is a fatty acid, which is found in highest amounts in food products derived from ruminants, and is safe at dietary levels. It is supposed that the effects vary with the specific isomers of CLA and the type and site of the cell/organ as well as the stage of tumorigenesis (Khanal., 2004).

CLA reportedly has anti-carcinogenic effects at various stages of cancer development, including initiation, progression and metastasis. Proposed mechanisms of CLA and its anti-carcinogenic activities include a reduction in cell proliferation, and prostaglandin metabolism. CLA seems to significantly reduce prostaglandin E synthesis which could inhibit tumor formation. It has been demonstrated that CLA has the ability to affect mammary cancer, stomach cancer, skin cancer and prostate cancer. The mechanisms by which CLA affects carcinogenesis are largely unresolved and may vary for different sites, age, duration of exposure and stage of carcinogenesis. Various studies suggest that CLA may act by antioxidant mechanisms, pro-oxidant cytotoxicity, inhibition of nucleotide synthesis, reduction of proliferative activity and inhibition of both DNA adduct formation and carcinogen activation. Most of the anticarcinogens are of plant origin, but CLA is unique because it is present in food from animal sources and its anti-cancer efficacy is expressed at concentrations close to human consumption level. The unique structural and functional properties of CLA appear to modulate cellular process involved in carcinogenesis. (Ip et al., 1994; Belury, 2002a; Alkalin et al. 2006; Silva et al., 2014).

Experimental animal studies indicate that CLA may have beneficial effects on the inhibition of the atherosclerotic process (Deckere et al., 1999). The anti-atherogenic effects of CLA have been established in animal models, as outcomes of changes in lipoprotein and cholesterol effects (Bauman and Lock, 2010). The effect of CLA on atherosclerosis in humans is studied by an indirect approach by measuring various potential heart disease markers, which are favorably influenced by CLA (Belury, 2002b; Khanal, 2004; Valeille et al., 2004). It has been reported that CLA can reduce plasma lipoproteins and early atherosclerosis in animal models, and can impaire glucose tolerance in diabetic rats (Lee et al., 1994; Houseknecht et al., 1998). Moreover, there studies according which CLA has an effect on the reduction of lipid uptake by adipocytes which leads to the reduction in body fat gain (Pariza et al., 2003). In animal models CLA has been shown to decrease body fat while not affecting total body mass. Dietary CLA supplements increase lean tissue deposition and decreases fat deposition in pigs (Ostrowskaet al. 1999). The mechanism by which CLA leads to a decrease in fat deposition is unknown. Conjugated linoleic acid seems to cause a loss of appetite in human subjects (Park et al. 1997 a,b). Experimental studies also indicate that CLA treatment can enhance lipolysis. Therefore, the decrease in body fat associated with CLA may be partially a result of reduced fat deposition and increased lipolysis in adipocytes, possibly coupled with increased fatty acid oxidation in both skeletal muscle cells (the principal site of fatty acid oxidation) and adipocytes (the principal site of fat storage) (Pariza et al., 2001; Silva et al., 2014)

Research evidences suggest that CLA influences the immune system by altering the effects of cytokine, interleukin, leukotriene and many immunoglobulins. Yu et al. (2002) has shown that CLA exhibits anti-inflammatory effects by negatively regulating the expression of certain pro-inflammatory genes. Also, CLA has been shown to have immunomodulatory properties by enhancing mitogen induced lymphocyte blastogenesis, lymphocyte cytotoxic activity and macrophage killing ability (Cook et al., 1993). Studies on animal models suggest that CLA is effective in preventing the catabolic effect of immune stimulation, and is a potent immunostimulator in mammals (Cook et al., 1993; Hayek et al. 1999)

According literature data CLA may have therapeutic potential in managing type 2 diabetes. CLA has been shown to improve oral glucose tolerance and delay the development of diabetes in rat models (Silva et al 2014). In a human study, CLA decreased fasting blood glucose concentrations in patients with type 2 diabetes (Belury et al., 2003).

CONCLUSION

Study of bioactive compounds of milk fat can be exploited for their applications in functional foods and for potential pharmaceutical use. Recent discoveries in the functional foods area indicate that specific fatty acids produced in the rumen may have beneficial effects on human health, and there is an increased interest in the possibility of designing natural food products with enhanced levels of these fatty acids.

CLA isomers are predominant polyunsaturated fatty acids (PUFA) found in products originating from ruminant animals whose beneficial effects on the human health are evidenced in numerous researches.

Taking in advance the health benefits of some constitutes of milk fat, future research can be forwarded to improve the nutritive value and health benefits of milk. Because the feeding regime of dairy animal is the predominant factor affecting milk fat, future research should be directed to alter the composition of milk fat and enhance the concentration of fatty acids which have beneficial health effects in humans. Natural enrichment of food products through manipulation of animal diet may contribute to the overall goal for obtaining the positive health benefits associated with CLA.

REFERENCES

Akalin S., Gönç S., Ünal G. (2006): Functional Properties of Bioactive Components of Milk Fat in Metabolism. Pakistan Journal of Nutrition 5 (3) pp: 194-197.

Bauman D.E., Perfield J.W., de Veth M.J., Lock A.L (2003): New Perspectives on Lipid digestion and Metabolism in Ruminants. Proc. Cornell Nutr. Conf. pp: 175 –189.

Bauman D.E., Lock A.L. (2010): Milk Fatty Acid Composition: Challenges and Opportunities Related to Human Health. World Buiatric Congress. pp: 278-289.

Barbosa E., Oliveira C., Casal S., Soares L., Vale A.P., Lopes J.C., Oliveira B., Brito N.V. (2003): Quantification and Variability of Conjugated Linoleic Acids in Sheep Milk of Two Autochthonous Portuguese Breeds. EJEAF Che. 2 (4) pp: 493-497.

Belury M. A. (2002)a: Inhibition of Carcinogenesis by Conjugated Linoleic Acid: Potential Mechanisms of Action. J. Nutri. (132) pp: 2995- 2998.

Belury M. (2002)b: Dietary Conjugated Linoleic Acid in Health: Physiological Effects and Mechanisms of Action. Annu. Rev. Nutr. (22) pp: 505-531.

Belury M.A., Mahon A., Banni S. (2003): The Conjugated Linoleic Acid (CLA) isomer, t10c12-CLA is Inversely Associated with Changes in Body Weight and Serum Leptin in Subjects with Type 2 Diabetes Mellitus. J. Nutri. 133 pp: 257S-260S.

Chilliard Y., Ferlay A., Rouel J., Lamberet G. (2003): A Review of Nutritional and Physiological Factors Affecting Goat Milk Lipid Synthesis and Lipolysis. J. Dairy Sci. (86) pp: 1751–1770.

Christie W.W. (1990): Gas Chromatography and Lipids. The Oily Press. Bridgwater, Somerset, Scotland**.**

Griinari J.M., Corl B.A., Lacy., S.H., Chouinard P.Y., Nurmela K.V., Bauman D. E. (2000): Conjugated Linoleic Acid is Synthesized Endogenously in Lactating Dairy Cows by Delta (9)-Desaturase. J. Nutr. 130 (9) pp:2285-91.

deDeckere E.A.M., van Amelsvoort J.M., McNeill G.P., Jones P (1999): Effects of Conjugated Linoleic Acid (CLA) Isomers on Lipid Levels and Peroxisome Proliferation in the Hamster. Br. J. Nutr. 82 (4) pp:309-17.

Dhiman T.R., Nam S.H., Ure A.M. (2005): Factors Affecting Conjugated Linoleic Acid Content in Milk and Meat. Critical Reviews in Food Science and Nutrition (45) pp: 463–482.

Hayek M.G., Han S.N., Wu D., Watkins B.A., Meydani M., Dorsey J.L., Smith D.E. Meydani, S.N. (1999): Dietary Conjugated Linoleic Acid Influences the Immune Response of Young and Old C57BL/6NCrlBR mice. J. Nutr. (129) pp:32-38.

Houseknecht K.L., Vanden-Heuvel J.P., Moya-Camarena S.Y., Portocarrero C.P., Peck L.P., Nickle K.P., Belury M.A. (1998): Dietary Conjugated Linoleic Acid Normalizes Impaired Glucose Tolerance in the Zucker Diabetic Fatty Rat. Biochemical Biopsy. Res. Comm. (244): 678-682.

Ip C., Scimeca J.A., Thompson H.J. (1994). Conjugated Linoleic Acid, a Powerful Anticarcinogen From Animal Fat Sources. Cancer (74) pp:1050-1054.

Jensen R.G., Ferris A.M., Lammi-Keefe C.J. (1991): The Composition of Milk Fat. J. Dairy Sci. (74) pp:3228-3243.

Khanal R.S. (2004): Potential Health Benefits of Conjugated Linoleic Acid (CLA): A Review. Asian-Aust. J. Anim. Sci. 2004. 17 (9) pp: 1315-1328.

Lee K.N., Kritchevsky D., Pariza M.W. (1994): Conjugated Linoleic Acid and Atherosclerosis in Rabbits. Atherosclerosis. 108 pp:19-25.

MacGibbon A.H.K., Taylor M.W. (2006): Composition and Structure of Bovine Milk Lipids. In: Fox PF, McSweeney PLH, eds. Advanced dairy chemistry. New York: Springer. pp. 1-42.

McGuire M.A., McGuire M.M. (1999): Conjugated Linoleic Acid (CLA): A Ruminant Fatty Acid with Beneficial Effects on Human Health. Proceedings of the American Society of Animal Science. pp: 1-8.

Miller G.D., Jarvis J.K., McBean L.D. (2007): Handbook of Dairy Foods and Nutrition. Boca Raton, FL: National Dairy Council.

Pariza M.W., Park Y., Cook M.E. (2001): The Biologically Active Isomers of Conjugated Linoleic Acid. Progress in Lipid Research (40). pp: 283–298.

Pariza M.W., Park Y., Xu X., Ntambi J., Kang K. (2003): Speculation on the Mechanisms of Action of Conjugated Linoleic Acid. In: Advances in Conjugated Linoleic Acid Research. 2nd Edition. J. Sebedio, W.W. Christie and R. Adolf. AOCS Press, Champaign, IL, pp: 251 - 266.

Park Y., Storkson J.M., Albright K.J., Liu W., Pariza M.W. (1999)a: Evidence that the trans-10, cis-12 Isomer of Conjugated Linoleic Acid Induces Body Composition Changes in Mice. Lipids (34) pp: 235–241.

Park Y., Albright K.J., Storkson J.M., Liu W., Cook M.E., Pariza, M.W. (1999)b: Changes in Body Composition in Mice During Feeding Withdrawal of Conjugated Linoleic Acid. Lipids (34) pp:243–248.

Rogelj I. (2000): Milk, Dairy Products, Nutrition and Health. Food Technol. Biotechnol. 38 (2) pp: 143–147.

Sebedio JL., Gnädig S., Chardigny J.M (1999): Recent Advances in Conjugated Linoleic Acid, Curr Opin Clin Nutr Metab Care (2) pp: 499–506.

Shingfield K.J., Wallace R.J. (2014): Chapter 1: Synthesis of Conjugated Linoleic Acid in Ruminants and Humans, in Conjugated Linoleic Acids and Conjugated Vegetable Oils pp. 1-65 DOI: 10.1039/9781782620211-00001.

Silva R.R., Rodrigez L.B.O., Lisboa M de Melo., Pereria M.S., Souza S.O. (2014): Conjugated Linoleic Acid (CLA): A Review. International Journal of Applied Science and Technology. 4 (2) pp: 154-170.

Valeille K., Gripois D., Blouquit M.F., Souidi M., Riottot M., Bouthegourd J.C., Serougne C., Martin J.C (2004): Lipid Atherogenic Risk Markers Can be More Favorably Influenced by the cis-9, trans-11-octadecadienoate Isomer than a Conjugated Linoleic Acid Mixture or Fish Oil in Hamsters. Br. J. Nutr. 91 (2) pp:191-199.

Yu L., Adams D., Gabel M. (2002): Conjugated Linoleic Acid Isomers Differ in Their Free Radical Scavenging Properties. J. Agric. Food Chem. (50) pp: 4135 – 4140.