

Review

COW MILK

(For 3.1.4 Beta carotene increases immunity & omega 3 acts as a mind sharpener)

Introduction and health benefits of beta carotene (Immunity) & Omega fatty acids (Mind sharpener)

Beta carotene

Introduction

India is blessed with a great number of cattle (193.46 million) population (**20th Livestock Census, GOI, 2019**) and occupies the first position in the world in total milk production (187.7 MT) (**Basic Animal Husbandry Statistics, GOI, 2019**). Milk as well as other dairy products are rich source of nutrition, play a vital role in the human life cycle. As a global concern, milk is generally obtained from cows, buffaloes, sheep, goats, camels, etc. Human beings, if deprived of mothers milk depends on the other species for their requirement of milk and milk products. The major nutritious components of milk are water, proteins, carbohydrate, vitamins, minerals (ash), and fats (Miller et al., 2006) along with a most vital one i.e. carotenoids. Earlier reports stated that **β -carotene is present in cow milk but absent in buffalo, goat, and sheep milk** (Haug et al., 2007; Raynal et al., 2008; Ullah et al., 2016). However, these animals metabolized the carotenoids into vitamin-A and then pass them on to milk. β -carotene is also called pro-vitamin- A, as the human body, easily converts this component into retinol (vitamin-A)while. Vitamin-A is usually available as retinol,retinal and retinoic acid. This essential element and is involved in essential biological reactions such as cell expansion and development, reproduction, vision (sight), and various immune functions, etc. (Tome et al., 2009; Rodriguez et al., 2014). **In 2009, Morrissey and Hill reported that Beta carotene levels range between 3 and 50 μ g/100 ml in cow milk.** Moreover, the level varies with the breed of cows (Brodziak et al., 2020) as well as with the **other factors** such as **lactation stage** (Calderon et al., 2007), **season**, and **feeding system** (Ellis et al., 2007).

In 2019, Bertolini and his team published collaborative research in Technical University of Kemptorset, **Denmark**, Iowa State University, **Ames** and Bharatiya Agro Industries Foundation, Warje, Pune, **India** reported that the current intake levels of a Vitamin-A which is crucial for human health is very low in many developing countries such as **India** and malnutrition might be one of the reasons for this condition.

Beta-carotene is fat-soluble, and thus it is most efficiently absorbed in the presence of fat components. Therefore, milk is an ideal option for its delivery (Ribaya-Mercado, 2002). Consequently, selecting milk with high Beta-carotene content could be a decent approach to improve the nutritional value of milk (Berry et al., 2009). **Gir, Holstein cross, Jersey Cross, Tharparkar, and Sahiwal** breeds are well studied and authors have reported their beta carotene level as well as prospects (Bertolini et al., 2019). According to the recent reports, published by **ICAR-National Dairy Research Institute, Adugodi, Bangalore**, (Ashokan et al., Feb-2021) stated that beta carotene level is rich in grazing animals as compared to non-grazing ones.

The Lab reports from **NABL and TUV** of our proposed **GOOD MORNING'S Cow milk** product (reference number- **TUV(I)/18024/20-21/0032104371 A dated 18/03/2021** and **TUV(I)/18024/20-21/0032104371 A dated 12/05/2021**) confirmed that our product has sufficient levels of **Vitamin A, Omega 3, and Beta carotene**, and these levels satisfy the Recommended Dietary allowance USD-FCT officially published on government FSSAI website.

https://ffrc.fssai.gov.in/assets/media_gallery/file/world_milk_day_presentation_2020.pdf

Health benefits of Beta carotene

- **Recent reports from the press release on 8th June 2021, on the occasion of world milk day, from the webinar** jointly hosted by Global Alliance for Improved Nutrition (**GAIN**) and **FSSAI, India**, reported that **Vitamin A and D** plays a vital role in boosting immunity and health during the covid-19 pandemic situation.

https://fssai.gov.in/upload/press_release/2021/06/60b63dfb77e1ePress_Release_Fortified_milk_01_06_2021.pdf

- **National Institute of Health (USDA-NIH)** in their official newsletter “**MedlinePlus**” reported that **Beta-carotene** having an antioxidant property

protects cells from damage caused by substances called free radicals. (<https://medlineplus.gov/ency/article/002400.htm>).

- **National Institute of Health (US Department of Health and Human services- NIH)** in their dietary supplements fact sheets reported some effects of beta carotene on the health that are as follows
 - i) People who eat a lot of *foods* containing beta-carotene might have a lower risk of certain kinds of cancer, such as lung cancer, while, studies to date could not prove that vitamin A or beta-carotene *supplements* can help to prevent or lower the chances of dying from this disease.
 - ii) Age-related muscular degeneration (AMD), or the loss of central vision as an individual ages, is one of the most common causes of vision loss in older people. Among people with AMD who are at high risk of developing advanced AMD, a supplement containing antioxidants, zinc, and copper with or without **beta-carotene** has shown promise for slowing down the rate of vision loss.

Omega fatty acids

Introduction

The researcher **Kennelly in 1996**, reported that milk fat contains over 400 individual fatty acids and their isomers. Cow milk contains large amounts of saturated fatty acids (SFA), small amounts of monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), and **omega fatty acids** with beneficial effects on human health.

Omega-3 Fatty acid is a class of polyunsaturated fatty acid having a dual bond three atoms away from the terminal methyl group in their chemical configuration (hence, called **Omega-3**). The ***α-linolenic acid and Docosahexaenoic acid*** are well-reported examples of essential Omega-3 fatty acids (**Kumar et al., 2018**).

According to the **FSSAI report, published on 4 May 2017**, intake of a polyunsaturated fatty acid in our diet should be encouraged. The ideal ratio of omega3: omega 6 ranges from 1:1 to 1:5-10. The current diets are reported to have 1:15-20 Hence, **FSSAI** recommended including foods with high omega 3 content in the diet.

Health benefits of Omega fatty acids (mind sharpener)

- According to the FSSAI report 2020, **Omega 3 and omega 6 fatty acids** are linked to the production of many chemicals in the brain responsible for mood.
- Data published in the **National Institute of Health (A part of the U.S. Department of Health and Human Services)** reported that **omega-3s** provide energy for the body and are used to form eicosanoids. Eicosanoids are signaling molecules that have similar chemical structures to the fatty acids from which they are derived; they have wide-ranging functions in the body's cardiovascular, pulmonary immune, and endocrine systems. (<https://ods.od.nih.gov/factsheets/Omega3FattyAcids-HealthProfessional/#h7>).
- **In the same report by Sydenham et al., (2012)** they stated that a diet high in omega-3s is associated with a reduced risk of cognitive decline, Alzheimer's disease, and dementia. Because **DHA (a type of Omega 3 FA)** is an essential component of cellular membrane phospholipids in the brain, researchers hypothesize that **omega-3s might protect cognitive function by helping to maintain neuronal function and cell-membrane integrity within the brain.**
- **In 2019, Klaus Lange stated that** The role of **omega-3 polyunsaturated fatty acids** in physical health is well established, and their role in **mental health** is becoming increasingly evident. **Omega-3 fatty acids** are involved in a wide range of physiological functions that are related to neurogenesis, neurotransmission, and neuroinflammation; therefore, they play fundamental roles in the **development, functioning, and aging of the brain.**
- **Harvard Medical School in November 2016, (updated in May 2019), in their Harvard health letter, with the reference of Dr. McGinnis, stated that** **Omega 3 fatty acid** might promote healthier **brain cells and less deterioration of the brain.** (Online accessed 03/05/2021).
- **McCrorie and his research group in 2011,** reported applications of **conjugated linoleic acid** (type of Omega fatty acid) for improving immunity, treating hypercholesterolemia, obesity, or build lean body mass and help in preventing heart diseases (**McCrorie et al., 2011**).
- **In 2019, Gutierrez and his team reported that** **omega-3 fatty acids** exert major alterations on the activation of cells from both the innate and the adaptive immune systems, although the mechanisms for such regulation are

diverse. First, as a constitutive part of the cellular membrane, omega-3 fatty acids can regulate cell membrane properties, such as membrane fluidity or complex assembly in lipid rafts.

- **Chinnadurai et al., in 2013** first time reported antioxidant and antiatherogenic properties of the **conjugated linoleic acid (Omega fatty acid)** present in ghee suggesting this ghee can be used as a portion of potential food for **decreasing the risk of cardiovascular diseases**, particularly in India, where, ghee is widely used for culinary and medicinal purposes.
- **Kim and his research group in 2006**, performed experiments on rats and reported that **conjugated linoleic acid (Omega fatty acid)** might modify the antioxidant system by a different mechanism in the **brain**.

References:

- 20th Livestock Census-All India Report (2019) Department Of Animal Husbandry and Dairying. Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India.
- Basic Animal Husbandry Statistics. (2019) Department Of Animal Husbandry and Dairying. Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India.
- Miller, G.D., Jarvis, J.K. & McBean, L.D. (2006) Handbook of Dairy Foods and Nutrition. CRC Press, Boca Raton, FL.
- Raynal LK, Lagriffoul G, Paccard P, Guillet I, Chilliard Y.(2008). Composition of goat and sheep milk products: An update. Small Ruminant Research, 79: 57±72.
- Ullah R, Khan S, Ali H, Bilal M, Saleem M, Mahmood A, et al. (2016). Raman-spectroscopy-based differentiation between cow and buffalo milk. Journal of Raman spectroscopy.
- Haug, A., A. T. Hostmark, and O. M. Harstad. (2007). Bovine milk in human nutrition—A review. Lipids Health Dis. 6:25–40.
- Tome D, Schwarz J, Darcel N, Fromentin G. (2009). Protein, amino acids, vagus nerve signaling, and the brain. The American journal of clinical nutrition, 90(3): 838S±843S.
- Rodriguez MAP, Petrini J, Ferreira EM, Mourao LRMB, Salvian M, Cassoli LD, et al. (2014). Concordance analysis between estimation methods of milk fatty acid content. Food Chemistry 2014; 156: 170-175.

- Calderon, F., B. Chauveau-Duriot, B. Graulet, M. Doreau, and P. Noziere. (2007). Variation in carotenoids, vitamin A and E, and color in cow's plasma and milk during late pregnancy and the first three months of lactation. *J. Dairy Sci.* 90:2335–2346.
- Ellis, K. A., A. Monteiro, G. T. Innocent, D. Et al.,. (2007). Investigation of the vitamins A and E and β -carotene content in milk from UK organic and conventional dairy farms. *J. Dairy Res.* 74:484–491.
- Brodziak Aneta, Król Jolanta, Barłowska Joanna, Zygmunt Litwińczuk, Teter Anna, Monika Kędzierska-Matysek (2020). Differences in bioactive protein and vitamin D status of milk obtained from Polish local breeds of cows. *Ann. Anim. Sci.*, Vol. 20, No. 1, 287–29.
- Ribaya-Mercado, J. D. (2002). Influence of dietary fat on β -carotene absorption and bioconversion into vitamin A. *Nutr. Rev.* 60:104–110.
- Berry, S. D., S. R. Davis, E. M. Beattie, et al., (2009). Mutation in bovine β -carotene oxygenase 2 affects milk color. *Genetics* 182:923–926.
- Ashokan M, Kerekoppa P, Hallur S, et al., (2021). Differences in milk metabolites in Malnad Gidda (*Bos/6/2021 indicus*) cows reared under pasture based feeding system.
- Press release dated, 08/06/2021 Global Alliance for improved nutrition (GAIN) and FSSAI, India (https://ffrc.fssai.gov.in/assets/media_gallery/file/world_milk_day_presentation_2020.pdf).
- Kennelly JJ. The fatty acid composition of milk fat as influenced by feeding oilseeds. *Anim Feed Sci Tech* 1996;60:137-52.
- Kumar a, Tripathi S, Hans N, Pattnaik F, Naik S (2018). Ghee : Its Properties, Importance and Health Benefits. *Lipid Universe*, 6, 6-14.
- Sydenham E, Dangour AD, Lim WS. (2012). Omega 3 fatty acid for the prevention of cognitive decline and dementia. *Cochrane Database Syst Rev*;6:CD005379.
- Klaus W. Lange, Yukiko Nakamura (2019). The role of omega-3 polyunsaturated fatty acids in mental disorders. *Movement and Nutrition in Health and Disease*;4:73–82.
- McCrorie T, Keaveney E, Wallace J, Binns N, Livingstone M, (2011). Human health effects of conjugated linoleic acid from milk and supplements, *Nutr. Res. Rev.* 24. 206–227.
- Gutiérrez S, Svahn S and Johansson (2019) Effects of Omega-3 Fatty Acids on Immune Cells. *International journal of molecular sciences.* 20, 5028; doi:10.3390/ijms20205028.

- **Chinnadurai** K, Kanwal H, Tyagi A, Stanton C, Ross P, (2013). High conjugated linoleic acid enriched ghee (clarified butter) increases the antioxidant and antiatherogenic potency in female Wistar rats, *Lipids Health Dis.* 12, 121–129.
- **Kim** MS, Kim SN, Park HS. (2006). Conjugated linoleic acid (CLA) might modify antioxidant system by different mechanism in the brain and liver of chronic ethanol-treated rats. *FASEB J (Meeting Abstract Supplement)*. 20:A146.

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