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Review Article

A2 Milk: The Unknown Story About a Milk Protein

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Abstract

Milk is known as a nutritious food because it is considered as a good source of protein, fat, carbohydrates, vitamins and other various minerals, which are essential for sustaining and maintaining a healthy life. Milk protein has significant importance in human health and body functioning. They are also known as a good source of biologically active peptides. One part of milk protein is casein, which has different genetic variations out of which A1 and A2 are more common. The difference between A1 and A2 beta casein lies in the amino acid sequencing at 67th position. It has been claimed by researchers that milk containing A1 beta-casein protein consumption, may increase the chances of a number diseases, unlike consumption of A2 beta-casein containing milk. The paper aims to give a basic understanding about A1 and A2 beta-casein present in milk, their mechanism of action, effects on health and conclusions drawn by other researchers on this A1/A2 beta casein containing milk.

Keywords: A2 Milk; Milk Protein; Casein

Introduction

Milk from milch animal has been a source of good food from long back in history, which is still considered as a good food. Consumed milk may come from various sources like cow, buffalo, goat, yak, sheep, etc. out of which cow milk is much popular milk for human consumption. From infants to adults, a glass of milk has become a part of the daily meal, with a belief that the glass of milk would fulfill all the nutritional requirement of the human body which the other foods could not fulfill. Cow milk is known for its protein, lactose (milk sugar) and other micronutrients, which are very essential for a growing kid, a working person, pregnant mother, a sick patient or an old person. Benefits of cow milk consumption, was recognized long back by Ayurveda, i.e. stronger bones, brain growth, better immunity and intelligence. It can be found that milk contains high amount of moisture (85 - 90%) followed by protein, lactose, minerals and other micronutrients like vitamins, enzymes, other nitrogenous non-protein substances, etc. The carbohydrate present in milk is called lactose, which is a disaccharide made of two sugar units, glucose and galactose. Galactose is responsible for brain and nervous system development. The nitrogenous substances present in the milk can be classified in a number of parts, as shown in figure 1 [1,2].

Figure 1: Milk protein composition.

Milk protein contains all 9 essential amino acids, making milk protein suitable essential food for human. Total milk protein is categorized under two heads: casein and whey protein. Casein has the unique property of coagulation at or below pH 4.6, whereas the whey protein part remains in soluble form. Based on this acid coagulation property, the protein is classified as casein and whey protein. Approximately cow milk protein is made of 82 part casein and 18 part whey protein [1,3]. Milk protein consumption prevents chronic diseases like diabetes, muscle wasting, sarcopenia, atherosclerosis, hypertension, cardiovascular disease risk, osteoporosis etc. They are also known for their anti-carcinogenic effects, hypocholesterolemic effects, anti-hypertensive effects etc [4].

Many consumers are aware of benefits of consumption of milk protein and better health. Recently there has been a trend of A2 milk consumption in the prevention of various diseases like heart diseases, diabetes and few others. Consumers having a limited knowledge of this aspect would often find confusing and would get disoriented on deciding which milk to consume and for what justified reasons. This review article in brief discusses about A1 and A2 beta-casein protein and reviews the work of other researchers on this particular area. The paper is targeted particularly for the researchers working in the domain of dairy science and for general consumers to get an understanding about A1 and A2 beta-casein present in milk and its role in human health.

Beta-casein classification and A2 protein

As shown in figure 1, milk protein is divided into two major categories, i.e. casein and whey protein. The casein may be further classified as alpha, beta and gamma casein, out of which beta-casein is more prevalent and contains balanced proportions of essential amino acids. Beta-casein comes in twelve genetic variations, namely A1, A2, A3, B, C, D, E, F, H1, H2, I and G. Out of these twelve variations, A1, A2 and B forms are the commonly found genetic variations [5]. A1 and A2 beta-casein protein differs from each other in single amino acid sequencing at "67th" position. For A2 beta-casein protein, at 67th place "Proline" is present, whereas for A1 beta-casein protein in 67th place, "Histidine" is found [6,7]. This polymorphism is responsible to cause changes in digestion patterns. A1 beta-casein digestion by digestive enzymes develops bioactive seven-amino-acid peptide called as "Beta-Casomorphin-7" (BCM-7) and on the other hand A2 beta casein digestion results in minimal development and least release of BCM-7. Bioactive peptide BCM-7, which is a strong opioid, was found to get released during gastrointestinal proteolytic digestion under *in-vitro* studies for beta-casein A1 and beta-casein B, but not for beta-casein A2 [8,9]. A1 beta-casein cow milk consumption was related to health risks like heart disease, type-I diabetes, sudden infant death syndrome etc [10-13].

A2 milk history and production aspect

Researchers became interested to understand the effects of proteins and peptides, and research was initiated to find the effects of peptides in human digestion and overall health [14,15]. In 1990's, RB Elliott and CNS McLachlan and collaborators reported that consumption of milk containing a particular class of protein may increase the chances of coronary heart diseases, Type-I diabetes and some other diseases. A1 beta-casein were found in the milk of Northern European native dairy cows like Friesian, Ayrshire, British Shorthorn and Holstein whereas, A2 beta-casein is found in milk of Channel Island cows, Guernsey and Jersey, in Southern French breeds, Charolais and Limousin and in the Zebu original cattle of Africa [16,17]. In another independent study on beta-casein, conducted by National Bureau of Animal Genetic Resources, Kamal, Haryana (India), it was found that milk of Indian milch breeds, i.e. Gir, Tharparkar, Rathi, Red Sindhi, Sahiwal, Kankrej and Hariana had A2 beta casein present [18]. A2 Corporation was established in New Zealand by Dr. Corran McLachlan, which initially started with the breeding of cows for A2 milk production, checking A2 protein, and afterwards launched A2 milk [6].

Agreements and Disagreements

Number of studies have reported about the benefits of consumption of milk containing A2 beta-casein, in prevention of diseases like coronary heart diseases, Type-I diabetes and others [10-13]. However, some studies have reported about no much scientifically established relation between the A1 beta-casein and human ill-health. Also requirement for more research based studies and human trials had been recommended by researchers to establish A1/A2 milk effects on human health. Swinburn [19] reviewed beta casein A1 and A2 and its effects on human health and submitted a report to New Zealand Food Safety Authority, which concluded that the hypothesis of occurrence of type 1 diabetes mellitus (DM-1) and ischaemic heart disease (IHD) promoted byA1 beta-casein, but also suggested need for more human based trials. The author, also commented that more research work and human trial data are required to establish the evidence of increased chances of autism and schizophrenia, because of A1 beta-casein containing milk consumption. Truswell [17] reviewed about A1 and A2 milk hypothesis and concluded no much convincing adverse effects of A1 beta-casein in human health. This review article was published in the Journal of European Journal of Clinical Nutrition, which was criticized by Woodford's [20] letter to the Editor of the same journal, with title "A critique of Truswell's A2 milk review". In the letter to the Editor, Woodford (2006) reviewed about scientific understanding and evidences about A1 and A2 beta casein in milk as important hypothesis. Kamiński., *et al*. [12] reported about their findings on polymorphism of bovine beta-casein on human health and

suggested higher level of BCM-7 as possible reason of sudden infant death syndrome, neurological disorders like autism and schizophrenia, although more work was suggested to verify the range and nature of interaction with human gastrointestinal tract and whole organism. Mishra., *et al.* [18] studied on beta-casein in different Indian milch animals and PCR genotyping protocol was adopted for differentiating A1 and A2 beta-casein variations, by referring Lien., *et al.* [21] and Kamiński., *et al.* [22] works. The work was concluded by stating the clinical implication of the negative effects of A1 milk is under discussion and more confirmation of claims to be made. It was further stated that an association of uncertainty about A1 and A2 milk, and there are requirement of further studies to confirm the health benefits of A2 milk on human health. Sodhi., *et al.* [7] also suggested need for more extensive research studies requirement for understanding BCM-7 interaction with human gastrointestinal tract and whole organism with need of more data on animal and human trials data on A1/A2 milk consumption. Ho., *et al.* [23] reported their blinded randomized study on effects of A1 and A2 beta casein on gastrointestinal effects. It was found that A1 beta-casein milk consumers resulted in higher BSS (Bristol Stool Scale) stool consistency values compared to A2 beta-casein milk consumers, which can be linked with BCM-7 release from digestion tract, for A1 beta casein containing milk. Beside this, A1 milk consumers had more abdominal pain with effects on stool consistency, compared to consumers on A2 milk. Pal., *et al.* [24] reported their finding on A1 beta casein present in cow milk and related it to milk intolerance for human health. Statistically it was also shown that human subjects who were given milk containing A1 beta casein suffered from more abdominal pain and stool consistency, unlike the human subjects, who consumed milk containing A2 beta casein. However, more future studies were recommended to establish the relationship between A1 milk consumption and milk intolerance.

Conclusion

A1 and A2 beta casein are overall similar, but only differing in amino acid sequencing at 67th position, resulting in release of BCM-7 during gastrointestinal proteolytic digestion of A1 beta casein, but not in A2 beta casein. A1 beta casein has been related to various disease risk factors like Type I Diabetes, coronary heart disease, etc. Experimental *in-vitro* studies and human studies confirms this hypothesis, however, more human trials in controlled conditions may be suggested for confirming this hypothesis with evidences. This hypothesis needs to be considered on a serious note and it is required to validate with proper research findings. Consumers should also be made more educated about the product they consume, for their own health benefits in the long run.

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