Neonatal and Pediatric Medicine
ISSN: 2572-4983
Qureshi, Neonat Pediatr Med 2023, 9:6
Mini Review
Open Access

Infant's Dietary Needs and Milk's Sugar and Protein Content

Saklain Qureshi*
Department of Pediatrics Medical College of Afghanistan, Afghanistan

Abstract

Glycophosphoproteins are multifunctional proteins found in all vertebrates. OPN is expressed in a wide variety of cell types and is present in most tissues and physiological secretions. OPN is involved in a variety of biological processes, including activation and regulation of the immune system. The process of tissue change, including the growth and development of the gut and brain. Interaction with bacteria. OPN is present at the highest concentrations in cow's milk and is thought to initiate and regulate developmental, immunological and physiological processes in cow-fed infants. Methods have been developed to isolate bovine OPN for use in infant milk, and many studies have been conducted in recent years on the effects of bovine OPN intake. The purpose of this article is to review and compare existing knowledge on the structure and function of milk OPNs, with a particular focus on their effects on human health and disease.

Keywords: Glycophosphoprotein; Milk; Bioactivity; Gastrointestinal digestion; Infant health; Immune regulation; Microbiota

Introduction

Glycophosphoproteins are pleiotropic proteins found in tissues and fluids throughout the animal kingdom. OPN was originally described as a secreted phosphoprotein associated with transformation and later identified in the extracellular matrix of bovine bone [1]. The name glycophosphoprotein ("osteo" is Greek for bone and "pontin" is derived from the Latin "pons" for bridge) was coined by Aldberg et al. shaped. I recommended. Because of its ability to act as a bridge between the cell and bone mineralization stages. OPN is also known as early T lymphocyte activation gene 1 (Eta-1), bone sialoprotein I (BSP I), secretory phosphoprotein-1 (SPP-1), uropontin, and lactopontin. This variety of names reflects the versatility of OPN and the variety of processes it involves [2].

Although encoded by a single gene, OPN is expressed by many different cell types and undergoes alternative splicing and extensive post-translational modifications depending on the site of expression. OPN is involved in numerous processes, including biomineralization, regulation of immune cell function, cancer metastasis, and breast, brain, and gastrointestinal development.

In 1989, OPN was purified from breast milk as an intact protein and possibly as fragments formed by proteolytic cleavage in milk. Several years later, OPN was isolated from milk and characterized. Recently, the milk protein ingredient Laprodan OPN-10© (Arla Foods Materials), which is over 95% bovine OPN, was recommended by the European Food Safety Authority (EFSA) for use as a novel food in infant formula. Milk OPN has been discussed by several groups so far. This review focuses on the cellular and physiological effects of milk-derived OPN as a dietary component and summarizes existing knowledge on human and milk-derived OPN [3].

Glycophosphoprotein in milk

Milk has been evolutionarily optimized to provide offspring with essential nutrients that can be used as building blocks and energy. In addition, cow's milk contains many bioactive molecules such as lipids, carbohydrates and proteins that affect the development and health of infants [4]. Many of these bioactive components are proteins that mediate functions such as antimicrobial activity, immunomodulation, mineral binding, and blood pressure regulation either directly or through encoded peptides released during digestion. A famous example is lactoferrin. Lactoferrin is an important carrier of iron and also releases antimicrobial fragments during digestion. Casein, especially β-casein, is susceptible to proteolytic cleavage in milk, probably due to the lack of secondary structure. Various biological activities are associated with casein peptides [5]. B. Mineral binding, immunomodulatory, antioxidant and antibacterial activity. A-Lactalbumin and β-lactoglobulin encode several peptides with biological activity within their sequences. B. Antihypertensive, opioid, antitumor, antioxidant, and immunomodulatory effects. In addition, many of the relatively minor milk proteins such as haptocorrins, lysozymes, EPV20 and MFGM proteins have been shown to possess biological functions that may be beneficial to offspring and milk consumers. Among these so-called secondary milk proteins, glycophosphoproteins have received a great deal of attention in recent years. OPN has been thoroughly characterized in bovine and human milk, but has also been identified and quantified in the milk of several other mammalian species. In orangutans (Pongo pygmaeus), relatively high levels of OPN are present in the early milk (measured by mass spectrometry, absolute quantification not reported), but OPN levels are low at 177 days after 1 year of lactation. In Gorilla, OPN reached a nadir at his 242 days, then increased and remained stable for the rest of the first year of lactation. A UHPLC-MS/MS (ultra-performance liquid chromatography-tandem mass spectrometry) study showed that the OPN concentration was estimated. and Yak (Bos grunniens). He reported two measurements per species [6].

Cattle (51.4 mg/L and 56.4 mg/L), buffalo (68.5 mg/L and 51.8 mg/L), yak (78.6 mg/L and 76.8 mg/L), sheep (41.06 mg/L and 29.8 mg/L) and goats (44.3 mg/L and 12.7 mg/L). A comprehensive proteomics study of camel milk revealed large seasonal variations in OPN concentrations, with OPN values increasing by 50% from winter

***Corresponding author:** Saklain Qureshi, Department of Pediatrics Medical College of Afghanistan, Afghanistan, E-mail: qureshisak@gmail.com

Received: 01-June-2023, Manuscript No: nnp-23-102655; **Editor assigned:** 07-June-2023, Pre-QCNo: nnp-23-102655(PQ); **Reviewed:** 21-June-2023, QCNo: nnp-23-102655; **Revised:** 23-June-2023, Manuscript No: nnp-23-102655(R); **Published:** 30-June-2023, DOI: 10.4172/2572-4983.1000321

Citation: Qureshi S (2023) Infant's Dietary Needs and Milk's Sugar and Protein Content. Neonat Pediatr Med 9: 321.

to summer. Measurement of OPN concentration in mouse milk by ELISA revealed that the average value was 150 mg/L in the early period of lactation (0-3 days), but decreased to about 10 mg/L after 8 days. From a health and commercial perspective, his OPN in humans and cattle have received the most attention, and this review will focus on the milk OPN in these species [7].

Glycophosphoprotein in bovine

OPN was first identified and isolated in 1993 from the protease peptone (the heat- and acid-stable portion of milk). The purification method involves heating milk to 90°C and adjusting the pH to 4.6 to precipitate casein, which is mostly denatured whey protein. OPN is an intrinsically disordered protein that remains in solution even after these relatively intense heat and acid treatments. It was then purified using a combination of size exclusion and ion exchange chromatography. Since then, gentler OPN cleaning methods have been developed. 8 mg OPN was isolated from 1 L milk by anion exchange followed by hydrophobic interaction chromatography and 11 mg OPN was purified from 1 L milk in a two-step anion exchange procedure. OPN is currently purified to >95% purity and can be used in commercial anion exchange-based infant formulas [8].

A comprehensive study of milk from 661 Danish Holstein cows revealed an average OPN concentration of 23.0 mg/L. This concentration corresponds to an average concentration of 18 mg/L measured in pooled milk. A study that analyzed OPN levels in the milk of just five cows found that OPN levels were significantly higher from birth to 25 weeks of lactation, hovering around 70 mg/L. After that, the concentration increased to about 150-250 mg/l between the 25th week and his 30th week. However, cows in this study were selected based on specific genetic variants that affect OPN promoter activity. A study using his MS/MS method on his two milk samples revealed an OPN concentration of his 53.9 mg/L [9].

Uptake of glycophosphoprotein

It has been shown that OPN from humans and cow's milk remains intact after incubation with neonatal gastric aspirate at pH 3 for 1 hour. This is somewhat surprising as OPN is an intrinsically disordered protein with low tertiary structure. Therefore, there is no steric hindrance for proteolytic enzymes to attack and digest proteins. However, its OPN undergoes extensive post-translational alterations in milk and these modifications play an important role in protein digestion.

The location of a glycosylated and conserved threonine residue near the key receptor-binding RGD motif suggests that the OPN-binding carbohydrate may function as a protective structure against endogenous milk proteases and/or digestive enzymes. Indeed, administration of exogenous milk OPN, but not unmodified OPN, decreased several disease parameters in the drinking water of a mouse model of colitis. This is suggested by his OPN mods like this:

B. Glycosylation. It has a protective effect on gastrointestinal digestion. The protective role of OPN glycosylation is that the glycosylated bovine OPN fragment Trp27-Phe151, which contains the integrin-binding motifs 136RGD138 and 139SVAYGLK145, resists digestion by pepsin, while deglycosylated OPN that binds the threonine/ proline loop is cleaved. This has been confirmed by studies showing it. The generated fragment Trp27-Phe151 was able to bind integrins better than the full-length OPN protein through the RGD sequence. However, subsequent digestion by pancreatic proteases that mimicked digestion in the small intestine disrupted their ability to bind integrins [10].

Lactoferrin complex

The interaction between milk OPN and lactoferrin has a dissociation constant of 10-6 M and a tricomplex ratio of 1 (lactoferrin: OPN). Human OPN and lactoferrin also form a complex in vitro. The lactoferrin-OPN complex has been shown to be more resistant to gastrointestinal digestion than the individual proteins alone, and complex formation increases binding and uptake by human enterocytes. This complex is localized in enterocytes with the major OPN receptor αVβ3 integrin, and the protein is internalized as a complex. Both bovine and human complexes promote human intestinal cell proliferation and differentiation by stimulating IL-18 expression and enhancing intestinal immunity. The biological activity of the bovine lactoferrin-OPN conjugate is also demonstrated when added to formulations of protein blends. Interestingly, the concentration ratios of the two proteins in cow's milk (~20 mg/L OPN, ~200 mg/L lactoferrin) and breast milk (~200 mg/L OPN, ~2000 mg/L lactoferrin) are the same.

Conclusion

In summary, OPN levels in breast milk range from 48 to 334 mg/L depending on the postpartum period and the geographic location of the mother. Most studies have shown a decline in OPN scores, which correlates with postnatal age. However, further research is needed to identify maternal and other factors that influence her OPN levels in breast milk.

The structures of her OPN in humans and milk are very similar in terms of overall sequence identity, phosphorylation and glycosylation patterns, integrin binding motifs, and proteolytic cleavage sites. It is believed that milk OPNs are partially resistant to digestion by intestinal proteases and some of the ingested OPNs reach the intestine in a form that can bind to integrins and trigger signaling events. Several studies have also shown that OPN or OPN fragments containing RGD are absorbed across the intestinal barrier, enter the circulatory system and organs, and may participate in physiological processes.

Milk OPN induces cytokine production in enterocytes and affects intestinal development and cell morphology. Additionally, several studies have shown that milk OPN is effective in reducing inflammatory bowel disease. Diet milk OPN affects the transcription of genes in the gut and influences the gut microbiota. Finally, milk OPN has been shown to improve immune parameters in infants fed OPN-containing milk and to affect cognitive development and behavior in animal models.

References

1. Singh (2016) A Randomized Controlled Clinical Trial on Swarna Prashana and its Immunomodulatory Activity in Neonates. Jam 7: 13-18.
2. Rathi R, Rathi B (2017) Efficacy of Suvarnaprashan in Preterm infants-A Comparative Pilot study J of Ind Sys Medi 5: 91.
3. Ismaili K, Hall M, Donner C, Thomas D, Vermeylen D, et al. (2003) Results of systematic screening for minor degrees of fetal renal pelvis dilatation in an unselected population. Am J Obstet Gynecol 188: 242-246.
4. Coplen DE, Austin PF, Yan Y, Blanco VM, Dicke JM (2006) The magnitude of fetal renal pelvic dilatation can identify obstructive postnatal hydronephrosis, and direct postnatal evaluation and management. J Urol 176: 724-727.
5. Grignon A, Filion R, Filiatrault D, Robitaille P, Homsy Y, et al. (1986) Urinary tract dilatation in utero: classification and clinical applications. Radiol 160: 645-647.
6. Ocheke IE, Antwi S, Gajjar P, McCulloch MI, Nourse P (2014) Pelvi-ureteric junction obstruction at Red Cross Children's Hospital, Cape Town:a six year review. Arab J Nephrol Trans 7: 33-36.
7. Capello SA, Kogan BA, Giorgi LJ Kaufman RP. Prenatal ultrasound has led to

earlier detection and repair of ureteropelvic junction obstruction. J Urol (2005) 174: 1425-1428.

8. Johnston JH, Evans JP, Glassberg KI, Shapiro SR (1977) Pelvic hydronephrosis in children: a review of 219 personal cases. J Urol 117: 97-101.

9. Williams DI, Kenawi MM (1976) The prognosis of pelviureteric obstruction in childhood: a review of 190 cases. Eur Urol 2: 57-63.

10. Lebowitz RL, Griscom NT (1977) Neonatal hydronephrosis: 146 cases. Radiol Clin North Am 15: 49-59.