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Calcium, Iron and Protein Levels in Human Breast Milk, Cow Milk and Baby Formula

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ABSTRACT

This research work investigated quantitatively the calcium, iron and protein levels in human breast milk, cow milk and baby formula (cowbell) to find the extent to which cow milk and/or infant formula can be used as replacement or supplement to human breast milk. Thirty samples comprising human breast milk from ten nursing mothers, cow milk from ten lactating cows and ten commercially purchased infant formulas were analyzed for protein, iron and calcium concentrations with Chemwell chemistry Autoanalyser. The study revealed a mean protein concentration of 1.48±0.46g/100ml in human breast milk, 3.57 ± 0.23g/100ml in cow milk and 1.40 ± 0.14g/100ml in infant formula. Mean iron concentrations were 0.38 ± 0.17mg/100ml in human breast milk, 0.64 ± 0.15mg/100ml in cow milk and 1.38 ± 0.39mg/100ml in infant formula. Calcium concentration was higher in human breast milk than in cow milk and infant formula.

Keywords: Human breast milk, cow milk, infant formula, comparison.

INTRODUCTION

Breast milk is a white liquid produced by the mammary glands of female mammals. Milk provides the primary source of nutrition for newborns before they are able to digest other types of food (Hylander et al., 2008). Human breast milk refers to the milk produced by a human mother to feed her baby to meet challenging needs during growth and maturation. Breast feeding success does not depend on the size of the breast or nipple, breast size is an inherited trait and determined by the number of fat cells (Fort et al., 2009).Milk synthesis and secretion by the mammary gland involves numerous cellular pathways and processes. The processing and packaging of nutrients within human milk changes over time as the pregnancy and recipient infant matures (Rodrigez et al., 2004).

RATIONALE OF STUDY

Supplements and/or replacements for human breast milk are commercially available. Various reasons have been advanced in support of alternatives like cow milk and infant formulas. In the United States, the term 'milk' refers to the milk of cows. The Food and Drug Administration of the United States Department of Agriculture defined milk as "the white, fresh, clear, lacteal secretion obtained by the complete milking of one or more healthy cows properly fed and kept, excluding that obtained days before and five days after calving or such longer period as may be necessary to render the milk practically custom free".

Infant formulas on the other hand, are food products designed to provide the nutritional needs of infants younger than 12 months of age if breast milk is not in use. Reasons for the use of infant formulas include the nature of mother's health; if infected, malnourished, taking harmful drugs, had breast surgery or the mother consumes food that contains an allergen and life style. Also when the baby is unable to breastfeed due to birth defects or inborn error of metabolism, or mother is absent and the child is adopted, orphaned or in sole custody of a man. In some cultures like nomadic North Africa tribes, infants do not receive sufficient sunlight to generate vitamin D as the child is always wrapped in cloth (Wagner, 2010). Thus the focus of this study was to investigate comparatively the protein, iron and calcium concentrations of human breast milk, cow milk and infant formula (cowbell).

METHODOLOGY

Ten samples each of human breast milk, cow milk and infant formula (cow bell) were used for quantitative analysis. Samples of human breast milk were collected from 10 lactating women that came for post natal care at the medical center, University of Nigeria, Nsukka. Cow milk samples were obtained from 10 cows at Ugwuoba, a village in Nsukka, where cattle rearers reside. Ten infant formula (cow bell) products were purchased commercially.

All the thrifty (30) samples were analyzed for protein, iron and calcium contents using an Autoanalyser (Chemwell 300, USA). Protein concentration is expressed in grams per 100ml (g/100ml), iron and calcium concentrations in milligram per 100ml (mg/100ml).

RESULT

Table 1: Protein Concentrations in Human Breast Milk, Cow Milk and Infant Formula (Grams/100ML)

S/NO	HUMAN BREAST MILK	COW MILK	INFANT FORMULA
1	1.02	3.60	1.30
2	1.09	3.74	1.45
3	1.64	3.34	1.26
4	1.52	3.40	1.34
5	1.94	3.52	1.5
6	1.42	3.80	1.40
7	1.73	3.64	1.54
8	1.68	3.39	1.39
9	1.20	3.58	1.50
10	1.25	3.62	1.48

Table 2: Iron Concentrations in Human Breast Milk, Cow Milk and infant Formula (Mg/100ML)

S/NO	HUMAN BREAST MILK	COW MILK	INFANTS FORMULA
1	0.25	0.60	1.00
2	0.30	0.79	1.12
3	0.45	0.50	1.34
4	0.21	0.49	0.99
5	0.40	0.70	1.77
6	0.50	0.65	1.65
7	0.35	0.55	1.50
8	0.55	0.60	1.70
9	0.29	0.54	1.40
10	0.39	0.75	1.20

Table 3: Calcium Concentrations in Human Breast Milk, Cow Milk and Infant Formula (Mg/100Ml)

S/NO	HUMAN BREAST MILK	COW MILK	INFANT FORMULA
1	0.72	0.45	0.20
2	0.75	0.42	0.22
3	0.60	0.54	0.16
4	0.62	0.49	0.18
5	0.59	0.50	0.24
6	0.57	0.44	0.21
7	0.74	0.51	0.20
8	0.58	0.52	0.23
9	0.67	0.43	0.19
10	0.55	0.49	0.17

The mean protein concentration in human breast milk (1.48 ± 0.46g/100ml) was lower than cow milk protein concentration of 3.57 ± 0.23g/100m and almost the same with infant formula protein concentration of 1.40 ± 0.14g/100ml.

Mean concentrations of iron in human breast milk, cow milk and infant formula were 0.38 ± 0.17mg/100ml, 064 ± 0.15mg/100ml and 1.38 ± 0.39mg/100ml respectively while the mean calcium concentration of 0.66 ± 0.09mg/100ml in human breast milk was higher than that in cow milk (0.48 ± 0.06mg/100ml and infant formula (0.20 ±0.04 mg/100ml).

DISCUSSION

Human milk is a unique, specific complex nutritive fluid with immunologic and growth promoting properties that evolve to meet the changing needs of the baby during growth and maturation. The earthy lactation milk known as colostrum carries the mother's antibodies to the baby and reduces the risk of many diseases (Bachach et al., 2011). The human breast milk is composed of two types of proteins; casein and whey. Casein, which accounts for 40% of protein in human milk and 80% in cow milk, has appropriate amino acid composition that is important for growth and development of infants. The whey contributing about 60% of proteins has great infection protection properties (Jeleh and Rattern, 2005). The balance of whey and casein allows for quick and easy digestion. The major protein fractions in whey are beta-lactoglobulin, alpha-lactalbumin, serum albumin and immunoglobulin, all with disease fighting properties (Singh, 2010).

Cow milk alone is not an appropriate diet for infants because the baby's kidneys may not work as efficiently as that of an adult. Cow milk also has too much protein especially casein, about 80%. The minerals are not easily absorbed and the protein inappropriate for use in the first year of life. They do not provide enough calories for growth or enough nutrients needed for normal development (Andiron et al., 2007).

Infant formulas vary in caloric density, nutrient composition and ingredients, digestibility, taste and cost. They are derived from cow milk, though dairy free formulas are available. When milk from the breast or from a cow is digested, it breaks down into two by-products, curd and whey (San Diego, 2007). The curd is white and rubbery while the whey is liquid. When cow milk breaks down, the curd that forms is hard for human babies to digest. The infant formula is an inferior artificial baby feed. It is static and often not tolerated well. Infant formula makers are striving to make their products contain more whey and less curd, so that they can be digested more like breast milk. Proper quantity of iron is important for the formation of haemoglobin required for transport of oxygen to the tissues while calcium is necessary in infants for growth and bone development. Cow milk and infant formula contain insufficient quantities calcium homeostasis.

Human milk contains antibodies (1gm, 1gA, 1gD, 1gG and 1gE) with secretary Immunoglobulin A (sIgA) as the most abundant. Milk derived sIgA is a significant source of passively acquired immunity for the infant during the weeks before the endogenous production of sIgA occurs (Goldman and Smith, 2008). During this period of reduced neonatal gut immune function, the infant has limited defense against pathogens. Maternal immunoglobulin A (IgA) antibodies derived from the gut and respiratory immune surveillance systems are transported via blood and lymphatic circulations to the mammary gland ultimately to be extruded into milk as sIgA.

In addition to antibodies, human milk has numerous factors that can affect the intestinal micro flora of the body. These factors enhance the colonization of some bacteria while inhibiting others. The immunologic components include lactoferrin which binds to iron, thus making it unavailable to pathogenic bacteria, lysozyme which enhances sIgA bactericidal activity against grain negative organisms, oligosaccharides which intercept bacteria and form harmless compounds that the baby excretes, milk lipids which damage membranes of enveloped viruses and mucus which adhere to bacteria and viruses to eliminate them from the body. Interferon and fibronectin also have antiviral activities and enhance energetic properties of milk leucocytes (Pearlman, 2009).

Breast milk contains ingredients that infant formula industries simply can't duplicate. Colostrum has a high concentration of antibodies especially IgA and antibodies that support the lungs, throat and intestine. It seals the permeable newborn intestine to prevent harmful substances from penetrating the gut. It has a laxative effect that helps the baby pass the first bowel movements (Smith and Goldman, 2004). All in all, breast milk is the gold-standard that infant formula companies are continually making efforts to match.

REFERENCES

Abdrain F., Dayi, S and Mete, E. (2007). Cow milk consumption in constipation and anal fissure in infants and young children. J. Peadiatr Child Health 39(5): 329-31

Bachrach, V.R., Schawrz, E and Bachrach, L.R (2011), Breast feeding and the risk of hospitalization for respiratory disease in infancy: a metal-analysis.

Arch Pediator Adolesc. Med 157(3): 237-45

Frot, P.,Moses, N. and Tasano et al. (2009). Brest and soy-formula feedings inearly infancy and the prevalence of autoimmune thyroid disease in children. J.A.M Coll Nutr 9 (2): 164-7

Goldman, A.S. and Smith, C.W. (2008). The Immune System of human milk, antimicrobial, anti-inflammatory and immunomodulating properties. Pediatric infection disease Journal 12(8): 664-71

Hylander, M.A., Jinobuno, D.M and Dhaniredy, R .(2008). Human milk feedings and infection among very low birth weight infants. Paediatrics 102 (3); 138-45

Jeleh, P and Rattray, W. (2005). Thermal denaturation of whey proteins in health induced changes in milk. 2nd end. Fox, P.F.ed 20(3): 37-41

Pearlman, W.H. (2009). Hormones and tissue growth factors in milk. Evolutionary implications. Endocr Regul 25(1-2) 4-9

Rodrigez, P.M, Koletzko, B. and kunz, C. (2004) .Nutritional and biochemistry properties of human milk, lipids, micronutrients and bioactive factors. Clin. Perinatal 26(2): 335-59

San Diego, C.A. (2007). Infant feeding in the 20th century: Formula and Beikost. Peadiatrics 14(4): 423-31

Singh, H (2010). Head induced changes in casein including interactions with whey proteins; in: Heat induced changes in milk. 2nd to Fox, P.F. ed. 13(3): 211-20.

Smith, C.W and Goldman, A.S (2004).The cells of human colostrum: in vitro studies of morphology and functions. Peadiatr Res 2(2): 103-9

Wagner, C.L (2010). Human milk as a nutritional and bioactive substance, in: Queen J.T. ed. Management of high risk pregnancy. 4th ed: 505-25