**Introduction:**

During the post natal period new-borns are exposed to a completely new environment, they experience an abrupt change from parenteral nutrition in the foetal period to exponentially enteral nutrition after birth occurs (Blum, 2006). The two major forms of immunity are; innate (natural) and acquired immunity. There are two basic types of acquired immunity; active- where an individual will come in contact with non-self antigens and will build up immunity to them, and passive- where an individual receives antibodies of an already immunised individual e.g. colostrum from mother to infant. At the time of birth the innate immune system is immature and the specific immune system is non-existent. In large animals, the placenta does not allow the transfer of maternal immunoglobulin’s before birth (in humans the placenta does facilitate this transfer). Therefore it is necessary for the newborn to receive passive immunisation from its mother until the active immune system is fully developed (Sinorka, 2003). Large farm animals, such as calves, piglets, foals and lambs, are dependent on intestinal transmission of immunoglobulin’s and other immune modulating factors that may be sourced from colostrum. (Sanglid, 2003)

In farm animals, Neonatal mortality is known to be of high incidence (10%). When a neonate is born it has low body energy stores and lacks serum immunoglobulins. Neonatal vitality has shown a strong correlation between the degree of passive immunisation and circulating immunoglobulin’s (particularly immunoglobulin G (IgG)) in ensuring a sufficient host defence against environmental antigens. Disease resistance has been shown to be greatly influenced by the extent of passive immunity received after birth (Sanglid, 2003).

Colostrum is the substance produced by animals directly post birth. It has a different composition to the milk of an animal in normal lactation period. The significant difference is the presence of IgG in colostrum and it is mainly the presence of IgG1 that is in highest concentration prior parturition. The time frame of the maximum transfer of IgGs from mother to infants is the first 48 hours post birth, (McConnell, Buchan, Borissenko, Brooks, 2001).

**Chemical Composition of Colostrum:**

Colostrum is said to contain nutrients such as, proteins, fats, lactose, essential fatty acids and amino acids. It also contains non-nutients, known as biologically active substances.

Cattle colostrum contains high amounts of growth factors and hormones. The growth factors which are mainly the insulin-like growth factors IGF-1 and IGF-2 and the hormone insulin. These growth factors and hormones play a significant role in the development of the gastrointestinal tract and the functional maturation of the animal during the first few days after birth (Blum, 2006).

Growth factors and biologically active peptides, hormones etc. in colostrum are said to regulate the adequate adaptation of new-borns to their new environment especially in the early post natal period. Studies showed that the stimulating effect of growth factors on the development and growth of the gastrointestinal tract is not only due to IGF-1 but rather to a set of growth factors. With an exogenous application of first colostrum, where growth factors were most abundant, there was a greater stimulation in the size of the intestinal villi than there was with the administration of just IGF-1 (Georgiev, 2008).

Along with IgGs being present in the colostrum, it can also contain cytokines, lysozyme, lactoferrin, lactoperoxidase which all help the immune system in fighting infection (McConnell, Buchan, Borissenko, Brooks, 2001).

In pigs, the function of the cytokines has not yet been clearly defined. In spite of this the findings of a study by Nyugen, T.V., Yuan, L. Azevedo, M. S. P., Jeong, K., Gonzalez, A., M., Saif, L. (2007), provides new information to support previously unrecognised roles of these cytokines. The results indicated that the highest cytokine absorption in suckled piglets occurred in the first two days which also coincided with gut closure. This high concentration of cytokines in the piglets serum could be due to the absorption across the intestinal wall.

**Physiological Importance of Colostrum:**

Colostrum provides the newborns with energy and maternal antibodies. it helps keep the animal warm and acts as a laxative which helps to remove fecal matter(meconium) in newborns digestive tract (Sjaastad, 2003).

The general view on absorption of macromolecules in the small intestine was that the immature ‘leaky’ epithelium was allowing the transfer of theses large macromolecules. However, although this may be the case for ions (sodium, chloride) and small molecules (lactulose, monosaccharidees), the different groups of molecules have different transport mechanisms by which they cross the epithelium. For example the intestinal enterocytes have the ability to absorb large amounts of immunoglobulins (Ig) by endocytosis. The ability to carry out this process develops close to term and disappears soon after birth in response to enteral feeding. Therefore, it is thought that an animal that is born prematurely may lack this ability. Hence the piglets, lambs and calves that were born prematurely showed a decreased ability to absorb intact protein molecules (Sanglid, 2003)

# The other important physiological role of colostrum is its stimulation of the development of the newborns gastrointestinal tract (GIT). This occurs through both nutritive and non-nutritive factors such as hormones and growth factors. As a result of this glucose absorbtion is improved and a rise in hepatic glycogen concentrations can be noted in new-borns fed from colostrum from birth in comparison to new-borns fed non-colostrum milk after birth (Hammon, Steinhoff-Wagner, Flor, Schönhusen, Metges, 2012)

In the newborn farm animal the immunoglobulin in colostrum is absorbed through intestinal epithelium without degradation. In piglets, foals, lambs, and calves the absorption of Ig through the intestinal tract occurs mainly by a nonspecific endocytosis of macromolecules. However this absorption process tends to cease after 1-2 days of colostrum exposure. In pig the intestinal closure occurs around 6-12 hours after feeding colostrum and rapidly progresses after that so that complete closure is by the 24-36 hour. The factors inducing the closure are said to vary amongst species. These factors involve colostral and systemic factors as well as the maturity of the gut epithelium. For example, studies showed that glucocorticoids appear to reduce the capacity for and duration macromolecule transfer in suckling rats, whereas it has the opposite effect in pigs and new born lambs (Sanglid, 2003).

Xu, Chen, Gao, Du carried out research that investigated the in vivo and in vitro effects of IgG against 17 strains of diarrhoea bacteria from bovine colostrum. They based their research mainly on the fact that the main cause of illness and morbidity in newborns is a result of intestinal infections from rotavirus, eneteropathogenic and eneterotoxigenic E Coli, Shigella and salmonella. From their research they concluded that newborns gain protection from environmental pathogens through antiboidies mainly IgG from the colostrum. This passive immunity is of crucial importance to the newborn calf until they establish their independent immunity, due to the fact that bovine animals don’t pass these antibodies through the placenta but through the colostrum only. Their research of past experiements also found that the stimulation of in vivo B lymphocytes will trigger an immune response that will increase the number of antibodies. This will specifically work on the introduced pathogens that the cows have been immunised against. The authors based their experiment on the research that they carried out from previous studies which showed the correlation between hyperimmunised colostrum providing protection against enteric diseases listed above. The cows were vaccinated with cells of 17 strains of pathogenic diarrhoea and colostral antibodies were excluded. The results showed an increased level of specific colostral IgGs in the cows that were immunized in the weeks prior to birth up until calving. To evaluate the quality of this immunity, highly purified IgGs were separated from both immunised (specific IgG isolated) and non immunised (normal IgG isaolated) colostrum using ammonium sulphate precipitation and verified by SDS-PAGE, and were incubated with pathogens. The results verified that specific IgG will inhibit in vitro growth and colonization in pathogens whereas the normal IgG were not capable of this level of inhibition. The results proved that IgGs provide very effective protection from multibacteria induced diarrhoea (Xu, Chen, Gao, Du, 2006).

**Importance of early administration of colostrum:**

The levels of IgG in colostrum in livestock is 10-40 times the concentration of plasma levels. This was closely studied in ruminants where it was found that there was a massive drop in plasma IgG1 levels in the last month pre-partuition. Its was also noted that days post calvint the levels of IgG of the milk was 1% of that in the colostrum, (Cervenak, Kacskovics, 2009).

The delay in colostrum intake by 24 hours after birth results in an increased concentration of non-esterified fatty acid, which is an indicator of energy deficiency in calves. Also, the intake of good quality colostrum increases the absorption capacity of the small intestine that is essential for the full utilization of nutrients and immunoglobulin’s. Thus, reinforcing the fact that colostrum has a strong stimulating effect on the anabolic processes of the new born especially when given early (Blum, 2006).

**Table 1. IgG transmission processes and the role of Fc receptors**

|  |  |  |  |
| --- | --- | --- | --- |
| **Species (Taxon)** | **Maternal secretion** | **Absorption by the young** | |
|  |  | **Prenatally** | **Postnatally** |
| Hen/chick (Aves) | Across the vitelline membrane surrounding the yolk | Yolk sac endoderm, FcRY[a](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn1) | Yolk sac endoderm, FcRY |
| Opossum (Theria) | Secretion into the pouch | No transmission | Small intestine, FcR[b](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn2) |
| Rabbit (Lagomorpha) | Uterine epithelium | Everted yolk sac, FcR[c](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn3) | No transmission |
| Rat/mice (Rodentia) | Mammary gland (milk), FcRn[d](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn4) | Everted yolk sac, FcRn[e](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn5) | Proximal small intestine, FcRn[f](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn6) |
| Human (Primates) |  | Placenta and foetal gut, FcRn[g](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn7) | No significant transmission |
| Cattle, sheep and pig (Artiodactyla) | Mammary gland (colostrum), FcRn[h](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn8) | No transmission | Small intestine, without FcRn[i](http://www.sciencedirect.com/science/article/pii/S0165242707000888#tbl1fn9) |
| Horse (Perissodactyla) | Mammary gland (colostrum) | No transmission | Small intestine |
| Dog (Carnivora) | Mammary gland | Placenta | Small intestine |

**Benfits of Future Research:**

From the above information, it is clear that colostrum is a vital component in the development of the newborns immune and gastro-intestinal system. Although extensive research has been carried out in this area already more indepth specific research could lead to overall better herd health and mortality rates for livestock.

