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Soy Milk as an Unconventional Alternative of Milk for Suckling Calves

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ABSTRACT

The major aim of using alternatives of milk is decreasing the cost of liquid feed in young calves raising program and enhance their productive performance. Milk replacers are an excellent source of liquid feed for pre-ruminant calves prior to weaning. It can be defined as an ingredient or mixture of feed ingredients that can be used as substitute for raw milk in feeding young calves. Total or partial substitution of whole milk with milk replacers for young calves feeding can significantly lower feed cost of calves raise. Soymilk is one of an important cheaper milk replacer which can be used for young calves feeding. It is a white emulsion, prepared by soyflour which resemble composition buffalos' milk in both consistency and appearance. And it's a good source of protein and energy. Soymilk contains on protein (35 g kg^{-1}), carbohydrates (29 g kg^{-1}), fat (20 g kg^{-1}) and ash (5 g kg^{-1}). When, its partially replaced whole milk led calves appetite toward fed dry starter, will encourage a propionate and butyrate production and lead to faster reticulorumen development. It was concluded that utilization of soymilk as a milk replacer for young calves had no negative effect of nutrient digestibility and nutritive value, growth performance and blood chemistry with replacement of suitable levels. Also, it has a good economic return.

Key words: Milk replacer, soymilk, pre-ruminant calves, feeding, digestibility, productive performance

INTRODUCTION

Nutritional strategies play a very important role for pre-ruminant calves feeding and explored as digestive system growth, development, health and cost are considered[1,2]. Raising young calves is one of the important jobs in the dairy farms because, it is very important economically. The calves were considered the future herd[3]. However, the first period (3 to 4 months) of calves' life was very sensitive and it has a special feeding program at this period. Milk is very preferred food for human and it has very precious[4,5]. Provide of nutrients for young calves with suitable way through liquid feed (whole milk or milk replacer) is very important for animal performance and welfare[6]. Total or partial substitution of whole milk with milk replacers for young calves feeding can significantly lower feed cost of calves raise. Whole milk or milk replacers were consumed by calves until their gastrointestinal tract is developed sufficiently and the ruminants become able to consume solid feeds by good healthy. Around 85.9% for dairy heifer farms owners are using milk replacers to calves feeding[7].

Growth of pre-ruminant calves requires a high quality protein[8]. While, the casein is not essential protein in the feed in this period for young calves, so it can be use alternative

proteins that more affordable in milk replacer or starter[9]. Moreover, calves able to use non-milk protein more effectively with age[10]. The use of alternative sources protein (plants or animals' protein) in milk replacers for diets young calves has increased as a result of increased milk prices and costs of raising calves[11].

Young calves require energy to grow properly, it has possessed negligible activity of soluble carbohydrates, insoluble carbohydrates and proteinases[12]. It is very necessary to provide moderately fermentable dry feed for timely establishment of fibrolytic, proteolytic and amylolytic capacities in the reticulorumen[12-14]. Addition of protease, xylanase and amylase enzymes are used to improve non-starch polysaccharides digestibility, also protein and starch consequently enhancing digestion in pre-ruminants fed diet contain corn and soybean meal[15]. Developing of reticulorumen early lead to lower weaning age, save milk and reduce calf-rearing cost[16-18].

Most of dairy heifer farms utilize milk replacers which containing a source of various ingredients such as skim milk powder (60-75%), animals or vegetable fat (15-25%), whey protein, butter milk powder (5-10%) soy lecithin (1-2%) and mineral-vitamin premix. A little proportion of ingredients like glucose, cereal flour and non-milk protein can also be used[19-23]. As a consequence of availability of new by-products and increased cost of traditional ingredients, milk replacer formulations have undergone considerable changes which taking into consideration milk composition and physical form[24].

Soymilk is a white emulsion which was like composition very close to that of buffalo's milk in both consistency and appearance[25]. It is prepared by soya bean seed powder. Also, it is inexpensive and good source of protein and calories. It was used as a cheaper milk replacer in developing countries[4]. Soymilk can be used as a partially milk replacer with whole milk during the first period of age when the young calves are very sensitive to plant protein and antinutrients factors. The soft adaptation for pre-ruminant calves to particular feeding strategy is fundamental to maintain calves during the early stage of digestive system development[17]. Supplementation exogenous enzyme products to soymilk lead to increasing availability nutrients already present in diet[26-28]. Partial substitution of milk with soymilk improves calves appetite when fed dry starter and promote propionate and butyrate production then fast reticulorumen development[29].

MILK REPLACER

Milk replacer is an excellent source of liquid feed for calves prior to weaning[30]. Milk replacer defined as an ingredient or mixture of feed ingredients that can be used as substitute for raw milk in feeding young calves[31]. Common ingredients of milk replacer are milk by-products (skim milk, casein, whey proteins) with addition of some other ingredients to get a final product identical to raw milk. The typical milk replacer comprises whey and skim milk powder and vegetable oils. Fat content ranges from 15 to 22% and crude protein content is usually 20% on dry matter basis[32]. Milk replacers are usually made up of source of various ingredients such as skim milk powder (60-75%), animal or vegetable fat (15-25%), whey protein, butter milk powder (5-10%) soy lecithin (1-2%) and mineral-vitamin premix. A little proportion of ingredients likes glucose, cereal flour and non-milk protein can also be used[19-23]. In developed countries milk replacer are formulated using milk processing industry by-products[33]. The major aim of using alternatives of milk is decreasing the cost of liquid feed in young calves raising program and it enhance their productive performance[32]. Protein is an important nutrient ingredient of milk alternatives. So, suitable sources of protein are a significant factor affecting diet quality and cost of animal production[34].

There are two types which can be used for milk replacer: milk protein and non-milk protein, milk protein is an excellent source of protein due to high quality through balanced amino acid constituents and free of anti-nutritional factors which noted as a high digestibility value. Due to high price of milk protein, many researches have illustrated soya bean protein as an alternative source of protein for milk replacer[35-37].

INGREDIENTS OF FEEDSTUFFS USED IN MILK REPLACERS

As a result of increased the cost of conventional ingredients feedstuffs and due to availability of more unconventional ingredients from processing industries, alternative of milk formulation has undergone considerable changes. Taking into consideration was physical form and its milk composition. Alternative of milk should be containing the basic ingredients such as protein, fat, lactose, vitamins and minerals which should be dissolved easily in the water to simplify feeding for calves[22, 23].

PROTEIN SOURCES IN MILK REPLACERS

There are many ingredients are utilized as replacer for milk protein and a mostly of vegetable ingredients[38]. However, this type of substitution may lower milk replacer quality and reducing growth performance and increasing morbidity[39]. The two most utilized ingredients to replace milk sources of protein are milk processing industries by-products such as (skim milk, dried whey, whey protein concentrate and delactosed whey as protein sources) and sources of protein

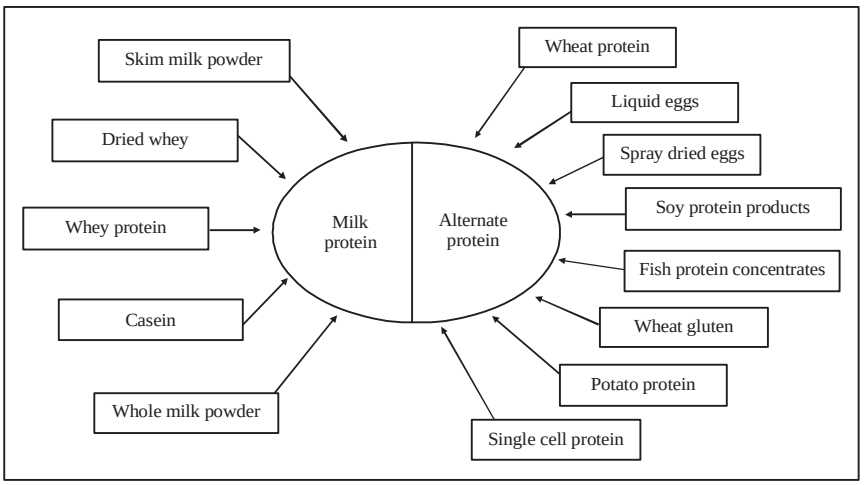

Fig. 1: Protein sources commonly used in alternate of milk formulation

other than milk by-products such as (soy protein concentrate, wheat protein, spray dried egg, fish protein concentrates, soy protein isolates, single cell protein and modified wheat gluten) are used in milk replacers (Fig. 1)[17,24].

Skim milk powder: Skim milk powder consider the most common replacer ingredient used in milk replacer formulation which reach up to 50% of the dry matter. Amount of non-casein nitrogen is contributed to save the whey protein in skim milk powder. Around 170 mg non-casein nitrogen per gram total nitrogen is very safe for utilized in milk replacers[40,41].

Whey: Whey is a by-product of cheese manufacturing and considered a common source of alternative protein for milk protein in milk replacer formulation. There are two types of whey product, dried whey which containing 13.5% protein while whey protein concentrate contains 37.1% protein. The whey protein digestibility varies depending on type of cheese, source of whey and processing and handling methods. Feeding young calves more than 20% of dry matter of whey results in diarrhea[24,41].

Whey protein: It is obtained from hydrochloric acid or heat coagulation in the presence of lactic acid. Whey protein does not complete coagulate in the abomasum when compare with whole milk. This is lead to abomasum emptying of feed is too faster for the whey protein diets than for whole milk[40].

Fish protein concentrate powder: There are two types of fish protein concentrate powder; soluble and insoluble. Soluble fish protein concentrate is obtained from controlled hydrolysis of protein in ground fresh fish. It has contained polypeptides with solubility of 80-100%. After the removal of bones and fat, the product is sterilized and spray dried. It has contained 85-90% protein, 2-5% fat, 4-6% ash. Insoluble fish protein concentrate is obtained by solvent extraction of the fat from ground fresh fish or fish meal and the product is crushed it to 35 micrometers. The product contains 80% protein, 1% fat, 10-15% ash. Generally, fish protein concentrates powder gives better results than soybean products. Both fish protein concentrates can be replaced up to 50-60% of the protein milk replacer for the first two months of calves' age with antibiotic as one of constituent in alternative of milk[42].

Spray dried whole eggs: Spray dried egg is a high-quality alternative feed due it contains of sufficient protein and fat. Moreover, it has a high-quality value of protein and fat contains phospholipid like lecithin which can give emulsifying properties to milk replacers if include as an ingredient. There are many of non-edible spray dried whole egg is produced from the egg processing industry. But there is a limitation to use it in animal feed because it contains several anti-nutritional proteins, such as protease inhibitors and avidin which irreversibly binds biotin. Supplementation of spray dried whole egg at 10% in milk replacer as a significant for whey protein concentrate lead to decreased growth performance on young calves with adding biotin to overcome the effect of avidin and balancing of milk alternative for amino acids methionine, lysine, leucine and threonine[43].

Liquid eggs: Utilization of liquid eggs as a substitute for protein at level 5% in alternative milk (13.5% of milk-based

protein) resulted in higher weight gain than in young calves fed complete-milk protein. While increased level of liquid eggs more than 10% in milk replacer (27% of milk-based protein) has negative effect on weight gain[44].

Soybean products: There are several products obtained from soya bean such as Soy Protein Concentrate (SPC), Soy Protein Isolates (SPI), soy flour and soy lecithin and soy phosphate. Using soybean products as a vegetable protein source in milk replacer was resulted in poor growth performance in spite of adequate amino acid balance[45]. This was due to it contains of enzyme inhibitors lectins and flatulence factors has been involved in weakness of digestion and metabolism in young calves. Also, using high levels of soy product has negative effect on growth performance calves[46,47].

Wheat gluten: It is a high-quality economical protein source which obtained from separating the gluten protein from wheat starch. Wheat gluten contains 80% protein and low fiber and ash[23]. The digestibility of crude protein and organic matter is a high as 95%. Also, it is free anti-nutrients factors such as those to soya bean protein products.

Potato protein isolates: It is a by-product of potato starch production, it has carbohydrate fraction removed through special processing which it removes inhibitors, allergens and anti-nutrients factors usually associated with plant protein. Biological value of potato protein isolates is about 80% compared to that egg protein as 100%[48].

Single cell proteins: It is a protein of bacteria, fungi or yeast grown on carbon sources substrate. Single cell proteins are a good source of protein which can be utilized to replace to around 20-40% of milk protein[49].

ENERGY SOURCES IN MILK REPLACERS

Fat: Many types of fat such as tallow, lard or vegetable oils are used as a source of energy in milk replacer. Recently, some countries are not permitted to using tallow to avoid the risk of transmitting Bovine Spongiform Encephalopathy (BSE) Disease. The fat can be affected on homogenization and digestibility. Animal fat and vegetable oil include large amounts of free fatty acids which poorly used by young calves. The recommendation varies for using concentration of fat in milk replacers, from 10-25%, a fat content beyond 10-12% is not needed for pre-ruminant calves[21]. Although pre-ruminant of sheep and buffalo this can be utilize higher at 20-25% of fat. The young calves less than 2 weeks of age do not digest non-milk fat as well as milk fat. However, milk alternative high in milk fat lower the diarrhea risk, the common fat source used are lard, tallow and coconut oil. For young calves it can be raised on a skim milk as a milk replacer alone with supplementary some vitamins such as A and D after the colostrum feeding period (one week of age). Also, growth performance rate will be lower when it's comparison with a whole milk diet and there will be a tendency for increasing risk of diarrhea. Incorporation of fat into milk replacers is made by two methods with blending fat by aid of an emulsifying agent in skim milk powder, or homogenization of fat into liquid skim milk, followed by drying, if necessary, gives the best quality product. Animal or vegetable fats should not be directly added to dried skim milk or liquid skim milk unless correctly emulsified, to give a small fat globule to a size of 3-4 micrometer in diameter. Young calves after 2-3 weeks of age can be tolerate larger fat globule. Generally, the small size globules of fat are more efficiently digested than those of larger size for the young calves in varies ages in the same breeds[40].

Carbohydrate: Carbohydrates are the second source of energy in milk replacer. The only sources of carbohydrate can digest by young calves is lactose. Using starch or its degradation products like maltose and dextrin as a source of carbohydrates in milk replacers are led to significantly lower digestibility during the first three weeks of age. The growth performance and digestibility were decreased in young calves at the first 3 week of life when it fed milk replacer contain less than 2% of starch in dry matter[50].

FEED ADDITIVES IN MILK REPLACERS

After the birth of pre-ruminant calves are separated from mothers and fed colostrum followed by milk replacer in bucket or a bottle. For minimize the occurrence of diarrhea, some practices should be adopted include enhancement housing and sanitation, reduce pathogen transmission. Antibiotics are one of additive which can be used for milk replacer to prevent bacterial infections and the use of fortified colostrum to improve immune defenses. Around 60% of milk alternatives fed to pre-ruminant calves of less than three weeks of life are medicated[51]. Although of this, nearly from 8-10% of calves was died in United States of America[52,53]. However, interest to finding antibiotics replacers has been increasing, against the background of growing public concern on the use of antibiotics in food animals. Some potential alternatives include oligosaccharides[54] and probiotics[55-57]. Many of these products have represent benefits in improving growth performance and healthy but the responses have been variable and inconsistent[21]. Interestingly, addition of

rumen liquor at 8 mL calf^{-1} daily along with colostrum and milk replacers until weaning lead to significantly decrease in incidence diarrhea and increase weight gain compared with control that did not fed rumen fluid[58]. Also, feeding of milk replacer contain of sodium butyrate at the rate of 3 g kg^{-1} of dry matter lead to improve reticulo-rumen weight[59] and body weight gain[60]. Therefore, feeding system and alternative of milk that encourage young calves to eat starter in early life of age are preferred. Whole milk contains Lactoferrin (LF), an iron-binding glycoprotein is beneficial as an animmuno-modulator[61] and as an antimicrobial[62]. Pre-ruminant calves fed milk replacers contains lactoferrin at 1 g calf^{-1} day^{-1} was increased body weight gain and consumed more starter feed during preweaning period.

SOYMILK AS A MILK REPLACER

Definition: Soymilk is a white emulsion, prepared by soya bean seed powder which resembles composition in buffalos' milk in both consistency and appearance[25]. It is a good source of protein and energy. It was utilized as a cheaper milk replacer in several countries[4]. Soymilk contains on protein (35 g kg^{-1}), carbohydrates (29 g kg^{-1}), fat (20 g kg^{-1}) and ash (5 g kg^{-1})[63]. Addition exogenous enzyme products to soymilk lead to increasing availability nutrients already present in diet[26]. When, its partially replaced whole milk led calves appetite toward fed dry starter, will encourage a propionate and butyrate production and lead to faster reticulorumen development[29]. Soybean includes anti-nutritional factors such as trypsin inhibitor, glycinin and β- conglycinin, which can reduce digestibility when it uses as protein source in milk replacers[64].

Production and preparation of soymilk: Soymilk was prepared from soyflour. Soybean was collected and cleaned by screening and hand picking of debris and stones. The cleaned soya bean was soaked for three days in plastic containers contains water. The water was changed twice daily during the soaking period. After that the soybean was rinsed with clean water and sun-dried for 8 days. The dried soybean was grinded into flour and sieved with the aid of 0.04 mm sieve (Fig. 2). For preparation of soy milk 12.5% of soy flour dissolved with water and boiled at 100°C for 10-15 min with constant stirring[65].

EFFECT OF SOYMILK AS A PARTIAL MILK REPLACER ON INTAKE AND FEED EFFICIENCY OF YOUNG CALVES

Several studies were carried out to investigate the effect of feeding soyflour in milk replacers in young calves. Soya bean

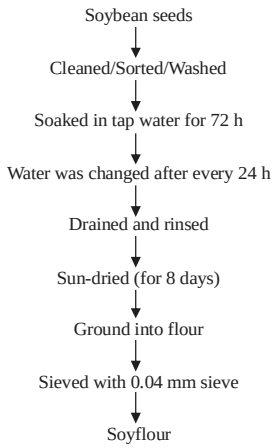

Fig. 2: The processing steps for soybeans into soyflour

flour as a source of protein was used in milk replacer for young calve feeding[66,67]. Gorrill and Nicholson[68] reported that soybean concentration (soymilk) could use as a major source of protein in milk replacers for young dairy calves. When, fed Holstein calves on milk replacer contains zero (whole milk) or 70% of total protein from soymilk with or without methionine supplementation. The digestibility of dry matter being 91 and 89% while the nitrogen supplied was 87 and 82% for whole milk and soymilk replacers, respectively. There was no difference in the growth rate, dry matter, pH or nitrogen content among groups, when young calves were started on experiment at 30 days of life age. Substitution of 73% soybean meal in total milk replacer protein resulted to less protein digestibility and lower fat and ash absorption without adverse effect on calf health[69]. Cooked soyflour contains inactive trypsin inhibitor but is converted to active when pH from 7-9. These mean new born calves often do not benefit well in milk alternative[70]. Feed efficiencies were improved with fed milk replacers containing 100% milk protein compared with replacement it with 66% modified soybean protein or 66% heated soybean flour for young calves. Also, these related to a higher digestibility and increased absorptive capacity of digested nutrients[71].

Hooper *et al.*[72] found that there was no different in intake of dry matter from milk replacers with proteolytic enzymes level or cofactor addition. While, increase the levels of proteolytic enzyme resulted to lower body weight gain by Holstein male calves during the preweaning and postweaning periods. When, it fed milk replacer containing 80% protein from a soy isolate and 20% protein from milk sources with or without addition of four levels of proteolytic enzymes or the presence or absence of a vitamin-mineral supplement (+ or - cofactor). Also, Shakya *et al.*[73] found that there was no significant

different in average daily dry matter intake, daily feed intake, protein intake and feed efficiency parameters from Murrah buffalo calves fed whole milk and soymilk in the proportion of 80:20. Akinyele and Harshbarger[10] reported that young calves were able to utilized soybean protein in milk replacers more effectively with age when fed calves on milk replacer containing soya bean protein by 26 and 30% of total protein for 12 weeks trial. Campos and Huber[74] found that utilization of soy protein concentrates in milk replacer resulted in lower dry matter and protein digestibilities. While, intake of nutrients, feed efficiencies were not affected between protein sources. When fed male Holstein calves on milk replacer containing milk protein by 100 or 50% soy bean protein concentration with limestone as a buffer.

Dawson *et al.*[64] observed that the experimentally heated soy flour and soya protein concentrations were superior to the commercially heated soy flour which can be used as a protein sources for milk replacer. When, fed young male calves milk replacers containing 75% from a soy product: experimental soy flour, commercial heated (fully cooked) soy flour and soy protein concentrate for eight weeks as sources of protein. Extruded soybean meal and fermented soybean meal could be utilized as a source of protein in milk replacers for pre-ruminant calves older than 20 days of life age. It has a positive effect on feed efficiency, but the protein efficiency not affected[75]. Soymilk intake by Holstein calves was lower than whole milk (control calves) when, its replacement whole milk with soymilk by (0, 25, 50%), also total dry matter intake of starter with soymilk fed was greater in calves fed whole milk and soymilk 25% than soymilk 50%[4]. Dry matter intake and TDN of Holstein-Kankrej crossbred calves was significant lower in group fed milk replacer containing soymeal, soy seed, maize, casein and molasses compared with group fed whole milk[76]. The nutrients digestibility of DM, OM, CP, NDF and ADF were significantly affected by the inclusion of soymilk at different ratios (0, 25, 50, 75%)[77].

EFFECT OF SOYMILK AS A MILK REPLACER ON BODY MEASUREMENTS AND GROWTH PERFORMANCE OF YOUNG CALVES

The effect of using soy products was as a source of protein in milk replacer on growth performance and body measurements. It was observed that Increased milk replacer protein content when energy was not limiting lead to increased lean gain while, increased fat gain found when protein content was limiting[78-80]. Also, daily growth of calves was directly related to milk alternative intake, when the protein was not limited factors[81]. While, there is a linearly increased of the average body weight gain and efficiency of feed conversion, when the amount crude protein in isocaloric milk alternative fed at 1.5% of body weight on dry matter basis[79]. There was no significant difference in the body weight gain, length, withers height and heart-girth of crossbred calves fed soymilk as milk replacer for raising calves[82]. While, Masum *et al.*[83] found that the body weight was increased for calves, when it fed milk replacer containing 50% raw milk and 50% soymilk plus vitamin-mineral premix. However, reduced body weight gains have been observed with increased soybean protein in milk replacers for pre-ruminant calves[71]. The young calves fed soymilk replacer had significantly decreased in body weight gain compared with those fed skim milk. Also, additional 0.5% of dry matter pepsin or pancreatin or both treatments together to soymilk replacer had reducing daily weight gain in calves[84]. Moreover, Campos and Huber[74] found that using of soy protein concentrates in milk replacer resulted in lower live body weight gains by 20%. There was significant decreased in daily body weight gain and total body weight gain in treatments compared with control. When, crossbred calves (Holstein Friesian x Deoni) fed milk replacer at a 30 and 40% of soymilk against cow milk[85]. Ghorbani *et al.*[4] found that body weight gain was increased for calves fed soymilk at 25% replacer or calves fed whole milk diet compared with that fed soymilk at 50% replacer. While, Shakya *et al.*[73] found that there was no significant different in growth, average daily body weight gain and body measurements (wither height and body length) from Murrah buffalo calves fed whole milk and soymilk in the proportion of 80:20. While, there are significant lower in growth rate and body measurements of Holstein-Kankrej crossbred calves fed milk replacer containing soymeal, soy seed, maize, casein and molases compared with group fed whole milk[74]. However, feeding calves with 25:75 ratio of soymilk: cow milk gave higher live weight gain than cow milk alone[86]. Yadav *et al.*[87] found that up to 80% milk can be substituted by soymilk with minerals, vitamins and enzymes without adverse effect of daily weight gain.

EFFECT OF SOYMILK AS A MILK REPLACER ON FECAL SCORE AND HEALTH OF YOUNG CALVES

Many studies were curried out to investigate using soymilk as a milk replacer on fecal score. Campos and Huber[74] found that fecal scores was not affected with different protein sources. When, Holstein calves fed milk replacers containing milk protein or 50% replaced with soy protein. Also, Huber *et al.*[88] conducted that fecal scores were not significant different between all experiments fed with increased quantity of milk.

The feeding milk replacer with antibiotics or enteroguard for Holstein calves was resulted in severity of scours as measured by fecal scores[89]. However, during the first two weeks of life age, Ghorbani *et al.*[4] reported that there are not differ in fecal score when calves fed milk replacer diets containing 25 or 50% from soymilk. Fiems *et al.*[90] observed that there are no affected in fecal scores when feeding Belgian Blue double-muscled female calves on milk replacer containing soy bean oil. Shakya *et al.*[73] found that there was no significant different in fecal score from Murrah buffalo calves fed whole milk and soymilk in the proportion of 80:20.

Seegraber and Morrill[91] observed that villi were tapering, uniform and long in calves fed milk compared with milk replacers containing sources of protein such as casein, soy protein concentrate, soy flour or fish protein concentrate. Calves fed milk replacers with casein had a higher variation size and conformation of villi. Also, it was found gradual deterioration in villous integrity in calves fed milk replacers with soy bean proteins. While the calves fed milk replacers with fish protein concentration had a poorly completely and abnormal villi. When, it changed the diets to raw milk test for reflex of effect after marked alterations in intestinal structure. It was observed that the atrophy was reversed toward shape and normal size within two weeks. The daily weight gain was increased and faces firmer in young calves fed whole milk than milk replacer.

The respiratory and enteric disorders are the famous main hazard, which can be infected the young calves rearing. The etiology of these diseases is reviewed by several studies to an attempt classify the factors into those of an immunological, genetic, microbiological, physical, psychological nature or nutritional[40]. The diarrhea infection is usually related with immune status of the calves and sanitary, management housing conditions rather than their milk or milk alternatives intake[92,93]. Therefore, Ghorbani *et al.*[4] found that fed calves soymilk by 25 or 50% from whole milk doesn't affect the happening of diarrhea in buffalo calves.

Blood hemoglobin (g dL^{-1}) and Packed Cell Volume (%) levels of Murrah buffalo calves were not affected with fed soymilk replacer up to 40% of whole milk[94,73]. Also, Average serum protein was not significant different in calves fed milk replacers containing different levels of soy bean as a source of protein[95]. No significant different in serum total protein, albumin and creatinine of Holstein-Kankrej crossbred calves fed milk replacer containing soymeal, soy seed, maize, casein and molases compared with group fed whole milk[76]. Packed Cell Volume (PCV), Hemoglobin concentration, WBC, Serum total protein, Albumin, glucose and creatinine were significantly higher in Friesian X Bunaji Dairy Calves fed 75:25 ratio of soy: cow milk compare with fed 100% whole milk. But, all blood parameters were within the normal range for healthy calves[86].

EFFECT OF SOYMILK AS A MILK REPLACER ON ECONOMICAL EVALUATION OF YOUNG CALVES REARING

In pre-ruminant calves feeding, the economic effect of suckling or liquid feeding is very important factor in livestock production[3]. Kamble *et al.*[85] found that using soymilk protein was more economical at level 40% replacement with cow milk protein, when, crossbred calves (Holstein Friesian. x Deoni) fed milk replacer at a 30 and 40% of soymilk against cow milk. Also, Ghorbani *et al.*[4] reported that substitution of 25 and 50% whole milk with soymilk is more efficiency and reduce the weaning costs by 35%, because soymilk was about 50% cheaper than whole milk. Therefore, the economic benefits were more eligibility by partial replacement of whole milk with soymilk without any adverse effect on calves healthy. Moreover, Masum *et al.*[82] reported that using soymilk as a milk replacer was 5.5 time than raw milk feeding, also it found combination of soy milk with whole milk was 1.6 time cheaper than whole milk feeding[83]. While, Khan *et al.*[31] observed that milk alternative is 117.39% less expensive than raw milk. Shakya *et al.*[73] concluded that soymilk replaces up to 40% from raw milk was reduce the cost of Murrah buffalo calf rearing. And, up to 80% from buffalo milk had good economic effect[87].

CONCLUSION

It is concluded that the use of soymilk as an alternative of milk for pre-ruminant calves had no negative effect on feed intake, nutrient digestibility and nutritive value, feed efficiency, body measurements, growth performance, fecal score and blood chemistry with replacement of the best suitable levels (low levels). Also, it is contributed to solve some problems related to increase in dairy products prices.

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