Nutritional Requirements of Dairy Buffalo

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Abstract

Buffalo (*Bubalus bubalis*) is one of the most important livestock species populated largely in tropical and sub-tropical countries. Balanced and economical feeding of Buffalo is extremely important for optimum productivity. Lower production is mainly due to the scarcity of feeds and unbalanced feeding practices. Proper nutritional management is the key to a successful Buffalo reproduction and health program. Increasing milk production of cattle through increasing dietary energy level is recognized in enhancing lactation potential. Buffaloes are mainly fed on crop residues and local grasses and need to be supplemented with deficient minerals for proper production performance. However, various problems must be discussed, including determining nutritional needs for buffalo growth, nutritional maintenance of metabolic and reproductive abnormalities, and recognition and utilization of the buffalo gut environment. Improved dairy buffalo nutrition in developing countries would involve extensive organized research and extension measures.

Keywords: buffalo, balance nutrition, nutritional requirement

Resumo

O búfalo (*Bubalus bubalis*) é uma das espécies pecuárias mais importantes, povoada em grande parte em países tropicais e subtropicais. A alimentação equilibrada e econômica de búfalos é extremamente importante para uma ótima produtividade. A menor produção se deve principalmente à escassez de rações e práticas alimentares desequilibradas. O manejo nutricional adequado é a chave para um programa bem-sucedido de reprodução e saúde de búfalos. O aumento da produção de leite do gado através do aumento do nível de energia da dieta é reconhecido no aumento do potencial de lactação. Os búfalos são alimentados principalmente com resíduos de culturas e gramíneas locais e precisam ser suplementados com minerais deficientes para um bom desempenho de produção. No entanto, vários problemas devem ser discutidos, incluindo a determinação das necessidades nutricionais para o crescimento do búfalo, manutenção nutricional de anormalidades metabólicas e reprodutivas e reconhecimento e utilização do ambiente do intestino bubalino. A melhoria da nutrição de búfalos leiteiros nos países em desenvolvimento envolveria extensa pesquisa organizada e medidas de extensão.

Palavras-chave: búfalo, nutrição balanceada, exigência nutricional

Resumen

El búfalo (Bubalus bubalis) es una de las especies de ganado más importantes pobladas principalmente en países tropicales y subtropicales. La alimentación equilibrada y económica de Buffalo es extremadamente importante para una productividad óptima. La menor producción se debe principalmente a la escasez de alimentos y prácticas de alimentación desequilibradas. El manejo nutricional adecuado es la clave para un programa exitoso de reproducción y salud de Buffalo. Se reconoce que el aumento de la producción de leche del ganado a través del aumento del nivel de energía dietética mejora el potencial de lactancia. Los búfalos se alimentan principalmente de residuos de cultivos y pastos locales y necesitan ser complementados con minerales deficientes para un rendimiento productivo adecuado. Sin embargo, se deben discutir varios problemas, incluida la determinación de las necesidades nutricionales para el crecimiento del búfalo, el mantenimiento nutricional de las anomalías metabólicas y reproductivas, y el reconocimiento y la utilización del entorno del intestino del búfalo. Mejorar la nutrición de las búfalas lecheras en los países en desarrollo implicaría una extensa investigación organizada y medidas de extensión.

Palabras clave: búfalo, equilibrar la nutrición, requerimiento nutricional

1. Introduction

Buffalo (*Bubalus bubalis)* is major contributor to milk, meat and leather production. Asian and Mediterranean buffaloes are the two types of buffaloes. Riverine and swamp buffaloes are two subspecies of Asian buffalo. Buffalo has become highly widespread in many areas due to its excellent milk quality, better able to adjust to various climates, particularly hot and humid climates, and to poor quality crop residue based fibrous diets, as well as their high fertility rates (Paul and Lal, 2010). The global buffalo population is estimated to be around 194.29 million people spread across 42 countries. Asia is home to 92.5 percent of the world's buffaloes. Approximately 71.32 percent of buffaloes are found in South Asia, 12.8 percent in East Asia, and only 8.4 percent in South-East Asia (Hamid et al., 2016).

Pakistan is the country with second-largest buffalo population and is the country's primary dairy species. Over 85% of whole buffaloes are produced in herds of 2-5 animals, suggesting the reliance on buffalo farming by a large number of households. Currently, the location, herd size, feeding practices, and marketing opportunities of buffalo production and feeding systems characterize them (Khan, 2009). Buffalo milk has more fat content, varying from 6 to 8.5 percent, due to its natural ability to manufacture it. Buffalo milk is preferred over cow milk in South Asian milk markets for its increased milk fat content (*Khan* et al*.*, 2008a).

Insufficient nutrients have been attributed for buffaloes' low per-head milk production, poor reproductive efficiency (seasonal breeding activity, anestrous behavior, and longer calving intervals) and slow growth. Buffalo efficiency can be improved with better nutrition and management (Sarwar et al., 2009).

Buffaloes are good converter of less quality forages to valuable products as compared to cattle. Buffaloes have a greater digestive potential than cattle when it comes to using low-quality roughage (Agarwal et al., 2009). Despite this, they convert low-quality fibrous feed and crop residues into muscle mass more efficiently than cattle (Sarwar et al. 2012). Wora-anu et al. (2000) discovered that swamp buffaloes have a higher population of rumen cellulolytic, proteolytic, and amylolytic bacteria than cattle fed identical diets, implying that their rumen micro flora enables them to consume low-quality, enriched-fiber diets.

The key problem of low output of buffaloes in several countries in Asia are erratic and insufficient supply of quality feedstuffs, as well as their usage. Buffaloes in Southeast Asia are mostly fed cereal straws, which are heavily lignified and poor in both fermentable protein and carbohydrates (Wynn et al., 2009).

2. Dairy Sector

Dairy production is needed not just to meet rising demand for protein, but also for economic and social purposes, since lactating animals provide a consistent source of income, effectively use family labor, provide social security and supply expanding markets (Sarwar et al., 2002).

Keeping in mind the potential of Pakistani buffalo, milk processing is the most useful and productive way of transforming crop residues and agro-industrial byproducts into good quality food in Pakistan, as it is in many other countries across the world.

Small herds, low genetic potential of animals for milk, inadequate marketing outlets, lack of technological resources for the dairy industry, significant ecological pressures, reproductive and udder anomalies, poor management practices, absence of commercial feed and lower use of milk replacers are all features of the Pakistani dairy industry, which are similar to those of other developing countries. Despite these issues, dairy animals in Pakistan, mostly buffalo and cattle, produce 48 million tons of milk (Anonymous, 2010).

3. Balance Feeding

For maximum output, animals must be fed in a balanced and cost-effective ration. The lack of feeds and unbalanced feeding methods are the key causes of reduced livestock production. The main reason for our dairy animals' low milk production is a lack of nutrients in both quality and quantity (Sarwar et al., 2002). Healthy nutrition and better management can help promote better performance and early sexual development (Heinrichs et al., 2005). The onset of puberty at the early stage (between 4 and 6.5 months of age) occurs due to high plan of feeding (Gasser et al., 2006). The animals fed with green fodder along with of 2.0 Kg concentrate ration reach maturity earlier (727.77 ± 44.17 days) than the control group (993.33 ± 68.78 days) (Rafiq et al., 2008).

Animals require specific minerals for the growth and skeleton development. Phosphorus is involved in the many metabolic process and cellular metabolism in the body, VFAs contents and bacteria in the rumen (Zain *et al*., 2010). Poor milk yield, slow development, high mortality rates, and poor reproduction output have all been caused by an insufficient supply of nutrients (Pasha and Khan, 2010). Nutritional manipulation to reduce nutrient losses and increase diet utilization performance in peri-urban buffaloes, according to Habib et al., (2007), would necessitate technological interventions in current traditional feeding systems.

4. Nutrient Requirements

4.1. Protein and energy requirements of buffaloes

Dairy and beef animals need both protein and energy in their diets (Table 1). Buffaloes, like other domestic animals' ruminants, consume fermentation byproducts to satisfy their nutritional and energy needs (microbial protein and volatile fatty acids). Buffalo's digestive physiology and nutritional needs have been compared to those of other animals including cattle and sheep in recent years (Puppo et al., 2002). Buffaloe's ruminal fiber and protein degradation was found to be higher than that of cattle and sheep. Buffaloes may have developed this unusual ability to better ferment fiber as a result of years of being fed low-quality, high-fiber feeds (Sarwar et al., 2005a).

During severe fodder shortages (May to June and November to December) in India and Pakistan, buffaloes are fully transferred to cereal straws to fulfill their energy and protein requirements (Khan et al., 2006c). The dry matter intake DMI ranges from 2.2 to 3.15 percent of BW in rising buffaloes (Khan et al., 2006c). Similarly, different researchers have published values ranging from 2.5 to 3.25 percent of BW for lactating buffaloes. Lactating buffaloes have also been given a reasonably accurate DMI prediction equation (Mandal et al., 2001).

Increasing milk production through increasing dietary energy level is recognized in enhancing lactation potential (Mahendra Singh, et al., 2014). Increasing dietary energy density through fat supplementation is the simplest procedure to avoid excess amount of carbohydrate with its concomitant problems of acidosis, greater heat loss as methane, increase feed bulk in the gastrointestinal tract and change the balance of other feed nutrients (Rajesh et al., 2014). Increasing dietary energy density, on the other hand, increased weight gain in lactating cows, according to Broderick (2003). Differences in species and lactation stages in laboratory animals may be the cause of this inconsistency. Furthermore, feeding buffaloes above the NRC level for large dairy breed cows had no effect on milk yield or daily benefit, and the excess was excreted unutilized, resulting in financial losses.

Increasing milk production of cattle through increasing dietary energy level is recognized in enhancing lactation potential (Ibrahim, 2001). The range of estimates of digestible crude protein DCP requirements for maintenance (g/kg MBS), growth (g/g gain) and milk production (g/kg 6% FCM) are 1.11-5.05, 0.20-0.45 and 53-68.6, respectively. Recent estimates of protein requirements derived by meta-analysis of pooled data of long-term feeding trials, which can be adopted as safe guide for feeding buffaloes, are as follows: Maintenance (per kg MBS): Growing: 3.60 to 5.05 g DCP or 6 to 7.6 g CP (Udeybir and Mandal, 2001); lactating: 3.14 g DCP or 5.43 g CP (Paul et al., 2002). Growth/weight change (per g gain): growing: 0.270.32 g DCP or 0.44-0.51 g CP; lactating: 0.23 g DCP or 0.33 g CP. Milk production (per kg 6%FCM): 55.2 g DCP or 90 g CP. The protein requirement values for Thai swamp buffaloes ranged 3.12 to 5.41g CP/kg MBS for maintenance and 0.46 to 0.60 g CP/g gain (Tatsapong, 2009), which is comparable to reported values for river buffaloes.

Lactating buffalo diets may have protein content as low as 12% DM. Recent study indicated that energy requirement for growth in buffalo heifers are comparable to those of male up to 250 kg BW but rapidly increases thereafter and the value is as high as 3.49 g TDN/g gain at 375 kg BW (Paul and Patil, 2007).

Several authors reported that protein contents in dairy buffalo diets can be as low as 12% DM, as these amounts have no effect on milk production quality and quantity. (Campanile et al., 1998). The ideal protein content was between 11 and 14% DM in the diet to stimulate ruminal micro flora.

Estimates of energy requirements for maintenance (g TDN/kg MBS) of different category of buffaloes were reviewed by (Paul & Lal, 2010) are as follows: Adult, 27 to 29.78; growing, 27.5 to 52 g and lactating, 35.3-49.2. Huge variation in these individual estimates is attributable mainly to difference in method of estimation. However, now estimates of maintenance requirements of energy by meta-analysis of pooled data of long-term feeding trials are available which are as follows: Growing: 35-39.9 g TDN/kg MBS (Udeybir& Mandal., 2001); Lactating: 35.3 g TDN/kg MBS (Paul et al., 2002). According to (Gong et al., 2002) sufficient dietary energy is an important element in dairy animals that can help them avoid negative energy balance and other metabolic problems. Tarazon-Herrera et al. (2000) discovered that dietary energy to the required amount improved feed quality (milk yield/DMI) in lactating cows.

When RDP concentration was higher from 50 to 82 percent in the dietary CP, Nisa et al. (2008) found that the CP digestibility of buffaloes was unaffected by dietary RDP/RUP. Buffaloes fed 50% RDP produced more milk and milk constituents (fat and protein) than those fed higher RDP levels. In Asia, berseem and lucerne are multi-cut legumes that are highly nutritious, high yielding, and widely available. However, because of their high protein and mineral content, these leguminous fodders have a high buffering ability and a high moisture content, which resulted in a less pH (Yahaya et al., 2004). According to Javaid, (2007) rising RUP in buffalo feeds reduced fertility in buffaloes fed iso-nitrogenous feeds linearly. Excessive consumption of CP, combined with elevated serum urea levels, may have resulted in ovarian activity being slowed (Qureshi et al.,2002).

4.2. Daily nutrient requirements of lactating buffaloes (Paul et al.*, 2002)*

The protein requirement values for Thai swamp buffaloes ranged 3.12 to 5.41g CP/kg MBS for maintenance and 0.46 to 0.60 g CP/g gain (Tatsapong, 2009). Javaid (2007) accessed the impact of changing the ruminally degradable protein (RDP) to undegradable protein (RUP) ratio on milk yield and reproductive efficiency in early lactating Nili-Ravi buffaloes Increasing the RDP to RUP ratio resulted in a linear reduction in DMI in early lactating buffaloes. The RDP to RUP ratio had a linear effect on DM digestibility, according to the findings.

To improve nutrient utilization in ruminant animals, yeast can widely be used (Francia et al., 2008). Increasing dietary energy density through fat supplementation is the simplest procedure to avoid excess amount of carbohydrate with its concomitant problems of acidosis, greater heat loss as methane, increase feed bulk in the gastrointestinal tract and change the balance of other feed nutrients. Supplemental fat sources are utilized in rations of dairy cows as a common method to increase the energy density of the ration to support energy demand for milk synthesis (Rabiee et al., 2012). Tripathi, (2014) stated that supplemental fat had modest advantage over addition of starch-based concentrate during summer heat condition.

4.3. Mineral Requirements in Buffalos

Mineral deficiency is attributed to lower performance and reproductive issues in livestock. Mineral deficiencies and imbalance are common in dairy animals, and the severity of the deficiency is dependent on the type of diet, the age of the animals, their physiological state, and the agro-climatic conditions of the area. Buffaloes are rarely given mineral supplements, with the exception of salt (Garg et al., 2005).

Buffaloes are primarily fed crop residues and local grasses, and their development and reproduction functions include supplementation with deficient minerals. In light of this, a region-specific mineral mixture was generated by analyzing macro and micro minerals in feeds and fodders. Groundnut, ragi, and soybean straws had high calcium (Ca) content (0.97 percent), while sorghum and paddy straws had low calcium (Ca) content (0.23 percent). Green fodder had a calcium content of 0.38 percent. Ca. had a particularly low concentration of concentrated ingredients (0.22 percent). Crop residues and green fodders had phosphorus (P) content of 0.14 and 0.19 percent, respectively, which was low, but concentrate ingredients had phosphorus (P) content of 0.67 percent, which was greater (Garg et al., 2007)

4.4. Vitamin

Vitamin D is a necessary component of mineral metabolism, especially calcium metabolism. It's in charge of converting calcium and phosphorus into 1,25dihydroxyvitamin D, which aids in the movement of these nutrients through the intestine. In the animal, vitamin A is contained as retinol. In dairy cattle, 14 7.3 mg of b-carotene converts to 1 mg of vitamin A. (Ferreira et al., 2017). Vitamin E is abundant in green forages, but it is typically supplemented as all-rac-a tocopheryl acetate (1 mg 14 1 IU) (NRC, 2001).

Table 1. Dry Matter Intake DMI, Protein and Energy requirement in Dairy Buffaloes

Buffalo Breed	**Protein Requirement**	**Energy Requirement**	**Dry Matter Intake**	**Author**
Thai swamp buffaloes	3.12 to 5.41g CP/kg MBS for maintenance and 0.46 to 0.60 g CP/g gain			Tatsapong (2009)
Nili-Ravi buffalo			2.5-3.25% of BW	Mandal et al. (2001)
Riverine buffaloes	3.14 g DCP or 5.43 g CP	1.97 g TDN/g gain	59.9 g/kg $W^{0.75}$	Paul et al. (2002)
Nili-Ravi buffalo	10% and 12% crude protein at 400 kg BW	3.49 g TDN/g gain at 375 kg BW		Paul &Patil (2007)
Nili-Ravi buffalo		35.3-49.2 g TDN/kg		Paul & Lal (2010)
Nili-Ravi buffalo		35.3 g TDN/kg MBS		Udeybir& Mandal. (2001)
Multiparous lactating Nili-Ravi buffaloes			15.94 kg/d	Jabbar et al (2013)
Nili-Ravi buffalo	166 to 126 g of digestible CP			Javaidet al. (2008)
Nili-Ravi buffaloes	13.4% CP	65.5% TDN		Ahmad et al. (2009)

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