Buffalo Milk: Saviour of Farmers and Consumers for Livelihood and Providing Nutrition

B.G. Mane*1 and M.K. Chatli1

1Assistant Professor, Department of Livestock Products Technology, COVAS, CSK HPKV, Palampur-176062 (HP), India.
2Professor and Head, Department of Livestock Products Technology, College of Veterinary Sciences, GADVASU, Ludhiana (PB), India.

*Corresponding Author: B. G. Mane
Email: manebandu@gmail.com

Received: 11/08/2015
Revised: 09/09/2015
Accepted: 10/09/2015

Abstract
The buffalo population has increased steadily since last three decades in India. The average milk yield of the buffaloes has increased mainly due to proper culling of unproductive buffaloes for slaughter. The culling of unproductive buffaloes and salvaging the male buffalo calves provides about 40-50 percent replacement price for productive buffalo and contributes for sustained buffalo production. The farmer recognizes this merit of buffaloes in addition to other advantages of buffalo keeping and accordingly prefers buffalo production. Positive relationship between growth in buffalo population, milk production and meat export indicate the need for sustaining buffalo meat exports with policy support for male buffalo rearing for meat. The advantages of buffalo milk as compared to cow milk in terms of physico-chemical, compositional, sensory, nutritional, health aspects, processing and product manufacture is another reason for farmers, processor and consumer preference over cow milk. In this brief review various aspects of buffalo rearing and production were discussed in farmers, consumers and other stake holders perspective.

Keywords: Buffaloes, Farmers and consumer choice, Dairy productivity, Milk quality.

1. Introduction
Buffaloes have emerged as significant contributors of livelihood, food security and nutrition to the masses because of its triple functions as a contributor of milk, meat and draught power (Kondaiah, 2015). Buffalo is one species being seen today as a saviour animal to meet man’s increased requirements of food in the coming times (Abdolghafour and Saghir, 2014). Buffalo population has increased steadily during the last 25 years. The share of adult female buffaloes in the total buffalo population increased from 46% in 1982 to 52% in 1992 and remained unchanged thereafter. In fact, total females account for more than 81% of the total buffalo population. Buffalo are now reared in almost all the states. Buffaloes out number cattle in Uttar Pradesh, Andhra Pradesh, Rajasthan, Gujarat, Punjab and Haryana which account for two-third of country’s total buffaloes. The above states are also the major milk producing states of India. (Source: 19th Livestock Census, held in 2012). As more than 85 percent buffalo production is with landless, small, marginal and semi-medium farmers, any improvement in buffalo production would largely benefit low income group. Buffalo herd size is increasing with the small and marginal farmers, an indicator of benefit derived by this category (Rangnekar, 2010). Review studies conducted to compare economics of milk production from cows and buffaloes indicated that buffalo production is more remunerative than cow (Gill and Singh, 1986; Pathak, 2003). The average milk yield from buffaloes was reported at 4.2 kg per day which is substantially higher than indigenous cows i.e 1.95 kg per day (Srivastava and Singh, 2010).

2. Farmers Preference for Buffalo Production
Buffalo milk gets higher price as it contains more fat, protein and mineral content as compared to cow milk. In addition to it buffaloes have got very good salvage value, and the value of the spent buffalo is very attractive for the dairy farmer. Buffaloes possess inherent resistance to several prevalent diseases, especially its resistance to diseases like FMD and tick born diseases. Buffalo is highly adaptive to the tropical climate of India, especially the high heat of North India.
(Laharia et al., 2010) and hence buffaloes are reared in all the agro-zones of India.

Various animal trials showed that protein efficiency ratio (PER) value of buffalo milk is higher than cow milk. Proteins of buffalo milk, particularly, the whey proteins are more resistant to heat denaturation as compared to the cow milk proteins. Buffaloes are known to be better at converting poor-quality roughage into milk and meat. They are reported to have a 5 percent higher digestibility of crude fibre than high-yielding cows; and a 4-5 percent higher efficiency of utilization of metabolic energy for milk production (Mudgal, 1988). Buffaloes have higher average milk yield per day as well as lactation milk yield which contribute substantially to its returns. Buffalo milk is preferred by commercial dairies as it is more suitable for a number of indigenous dairy products in view of higher fat, protein and lactose (Table 1). Buffaloes produce milk which is economically beneficial to producers, processors and consumers.

3. Residual Value of Buffalo

At the end of 6-7 lactations the cows and buffaloes become unproductive to the farmers and are to be replaced with young stock. While in case of buffaloes the unproductive animals fetch substantial returns ranging from Rs.15, 000 - 25,000 based on the size and condition of the animal which forms about 30 to 40 percent of the cost of replacement buffalo. The farmer recognizes this merit of buffaloes in addition to other advantages of buffalo keeping and accordingly prefers buffalo production. In addition growing buffalo meat exports, have further supplemented economic returns to the farmers. Therefore the relative merits of buffalo farming can be listed as:

- High adaptability of buffaloes to widely variable agro-climatic conditions.
- Comparatively less selective and capable of digesting greater proportion of roughages in diet.
- Higher solids in buffalo milk.
- Good market demand for buffalo milk.
- Higher price realization for buffalo milk due to fat based milk pricing system.
- More suitable for popular indigenous milk products.
- Desirable carcass and meat composition.
- Housing and management much easier.
- Posses better disease resistance as compared to cows, especially cross-bred cows.

4. Impact of Meat Export on Buffalo Productivity and Population

Over the decades milk production of buffaloes has increased primarily due to selective removal of unproductive and low producing animals from the system and making efficient use of scarce inputs of feed and fodders for productive animals. Despite an increase in human population, per capita milk availability in the country has increased from 217 g per day (in 2000) to 290 g per day (in 2012). This has been possible with significant contribution from buffaloes which comprises about 51% of total milk in the country. Buffalo milk yield in the country has improved from 3.96 kg in 2000 to 4.71 kg in 2012.

Uttar Pradesh has got the highest number of buffalo meat export houses, but at the same time it has got highest proportion of milk coming from buffaloes. In Uttar Pradesh, 68% of milk is produced from buffaloes and it is ever growing owing to triple monetary benefits of rearing buffaloes to the farmers. Buffaloes provide for not only milk but also draft power and at the end of the productive cycle, they have very remunerative salvage value, which helps the farmer to repurchase a new milking animal. Buffalo milk productivity in Uttar Pradesh (Table 2) has maintained a sustained improvement during the period 2000-2012.

During the period 2000-2012 average milk yield per buffalo in milk has increased by about 12 percent which along with increase in buffalo population resulted in 73.59 percent increase in total buffalo milk production. During the census periods 1997-2012 all India buffalo population increased from 89.92 m to 108.7 m showing an increase of 20.89 percent while milk buffaloes increased from 42.73 m to 51.05 m recording an increase of 19.47 percent. In comparison, during the same period Uttar Pradesh registered an increase of 61.21 percent in total buffaloes (from 19 m to 30.63 m) and an increase of 65.48 percent in milch buffaloes (from 8.43 m to 13.95 m).

A comparison of buffalo population, milk production and meat export over different census periods from 1977 - 2012 (Table 3 and Table 4) indicate a continuous increase in the buffalo population, total milk production and per capita increase in milk availability along with quantity of buffalo meat exported. Therefore looking at census data, we can observe a strong positive co-relation between increase in meat exports and increase in milk production.

Buffaloes have unique ability to utilise coarse feeds, straws and crop residues converting them into protein rich lean meat and is well fit in Indian situation having poor feed resources (Kandeean et al., 2013; Abdolghafour and Saghir, 2014). Buffaloes have become a preferred dairy animal for all categories of farmers due to the following advantages: They are -
Table 1: Average Milk yields of buffaloes and indigenous cows

<table>
<thead>
<tr>
<th>Year</th>
<th>Buffaloes Yield (kg/day)</th>
<th>Lactation yield* (kg)</th>
<th>Indigenous cows Yield (kg/day)</th>
<th>Lactation yield** (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
<td>3.83</td>
<td>1149</td>
<td>1.83</td>
<td>457</td>
</tr>
<tr>
<td>2000-01</td>
<td>4.05</td>
<td>1215</td>
<td>1.92</td>
<td>480</td>
</tr>
<tr>
<td>2004-05</td>
<td>4.29</td>
<td>1287</td>
<td>1.95</td>
<td>488</td>
</tr>
<tr>
<td>2009-10</td>
<td>4.53</td>
<td>1359</td>
<td>2.20</td>
<td>550</td>
</tr>
<tr>
<td>2012-13</td>
<td>4.80</td>
<td>1440</td>
<td>2.36</td>
<td>590</td>
</tr>
</tbody>
</table>

Source: BAHS 2014; *Lactation yield in buffaloes: yield(kg/day) multiplied by 300 days lactation length; **Lactation yield in indigenous cows: yield(kg/day) multiplied by 250 days lactation length

Table 2: Buffalo milk productivity in Uttar Pradesh

<table>
<thead>
<tr>
<th>Productivity Parameters</th>
<th>1999-2000</th>
<th>2011-2012</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average milk yield/buffalo in milk (Kg/day)</td>
<td>3.97</td>
<td>4.43</td>
<td>11.59</td>
</tr>
<tr>
<td>Buffalo milk production (mt)</td>
<td>9.42</td>
<td>16.33</td>
<td>73.35</td>
</tr>
<tr>
<td>Total milk production (mt)</td>
<td>14.15</td>
<td>23.97</td>
<td>69.40</td>
</tr>
<tr>
<td>Share of Buffalo milk, %</td>
<td>66.57</td>
<td>68.13</td>
<td>1.56</td>
</tr>
<tr>
<td>All India Buffalo milk production (mt)</td>
<td>42.27</td>
<td>65.35</td>
<td>54.60</td>
</tr>
<tr>
<td>Share of UP buffalo milk, %</td>
<td>22.29</td>
<td>24.99</td>
<td>2.70</td>
</tr>
</tbody>
</table>

Source: (BAHS, 2006; 2013).

Table 3: Comparison of Buffalo Population, Milk production and Export

<table>
<thead>
<tr>
<th>Census year</th>
<th>Buffalo Population (m)</th>
<th>Buffalo Milk Production (Million Tons)</th>
<th>Per capita availability of all milk</th>
<th>Buff Meat Export Qty (000 MT)</th>
<th>Buff Meat Export Value (Rs Crores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>62.00</td>
<td>15.68</td>
<td>125</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>1997</td>
<td>89.92</td>
<td>38.71</td>
<td>200</td>
<td>176</td>
<td>619</td>
</tr>
<tr>
<td>2003</td>
<td>97.92</td>
<td>47.98</td>
<td>224</td>
<td>298</td>
<td>1305</td>
</tr>
<tr>
<td>2007</td>
<td>105.34</td>
<td>56.63</td>
<td>251</td>
<td>494</td>
<td>3212</td>
</tr>
<tr>
<td>2012</td>
<td>108.70</td>
<td>67.68</td>
<td>290</td>
<td>1017</td>
<td>13818</td>
</tr>
</tbody>
</table>

Buffalo milk forms about 51-55 % of total milk production; *Figures for 1979-80; Data source: BAHS 2012; DAHD-AR 2012-13; APEDA

efficient converters of coarse feeds, straws and crop residues to milk and meat; More adaptable; easy marketing of buffaloes and products, easy to maintain and increased demand for the products- milk, meat and leather.

5. Improving Dairy Productivity

The farmers need to adopt scientific and modern aspects in buffalo production and the full potential of the species need to be realized. To identify a single important aspect for improving productivity would be preventing early age calf mortality and rearing them to optimum weights for better returns and sustainable population. Policy approaches and developmental programmes need to consider importance of buffaloes in providing livelihood and their role in Indian economy. The following aspects need consideration:

- Slaughter restrictions on utilization of male buffalo calves and other unproductive buffaloes need to be removed.
- Buffalo breeding programme needs to be implemented on war footing, with emphasis on better bull selection on basis of milk production, milk solids, fertility and other economic parameters.
- Buffalo farmers organizations need to be promoted for effective implementation of programmes related to productivity improvement and other scientific developments.
- Progeny testing programmes to be taken up with farmers awareness for selection of superior bulls and complementing artificial insemination programmes.

Agricultural Rural Development | Year-2015 | Volume 2 | Pages 05-11
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Crop residue based compound feed to be promoted in rural areas along with silage and other fodder development programmes.

FMD control programme to be implemented effectively for eradication of the economically important disease from the country.

Interests of all the stake holders of buffalo production and utilization need to be sustained for complementary development and contribution to National economy.

6. Merits of Buffalo Milk

There are a number of reviews available (Patil, 2010; Srivastava and Singh, 2010; Hofi, 2010; Singh and Hussain, 2010; Pandya, 2010; Sushil Kumar, 2010) showing the advantages of buffalo milk as compared to cow milk in terms of physico-chemical, compositional, sensory, nutritional, health aspects, processing and product manufacture etc. Buffalo milk was found superior to cow milk due to the desirable composition. The disadvantages of buffalo milk in comparison to cow for manufacture of some of the products like Chhana and some ripened cheeses have been overcome with technological findings.

- Buffalo milk has about 11.42% higher protein than cow milk. Animal bioassays have shown the Protein Efficiency Ratio (PER) value of buffalo milk proteins at 2.74 and that of cow milk at 2.49.
- Buffalo milk is also superior to cow milk in terms of important minerals, namely calcium, iron, and phosphorus, which are higher by 92, 37.7 and 118 per cent, respectively.
- Unlike the cow milk, which is pale cream yellow in colour, and cow milk fat, which is golden yellow in colour, buffalo milk is distinctively whiter. UHT-processed buffalo milk and cream are intrinsically whiter and more viscous than their cow milk counterparts, because of conversion of greater levels of calcium and phosphorus into the colloidal form. Buffalo milk is, therefore, more aptly suitable for the production of tea and coffee whiteners.
- Buffalo milk has very high fat content and the fat to protein ratio is about 2:1 and high casein to protein ratio (81-84 percent) compared to bovine milk (78 percent). The phospholipids of buffalo milk fat showed a definite antioxidative action due to higher content of cephalin, which is known to be a potent antioxidant.
- Buffalo milk has higher calorific value of 117 Calories/100g as compared to cow milk (89 Calories/100g), which is entirely due to the higher fat, lactose and protein contents in the former.
- The total cholesterol content was significantly higher in cow ghee (330 mg%) than in buffalo ghee (278 mg%) where as esterified cholesterol is significantly higher in Buffalo ghee (Bindal and Jain, 1973).
- Buffalo milk has 58% more calcium, 40% more protein and 43% less cholesterol than cow milk.
- Buffalo milk is also richer source of iron, phosphorus, vitamin A and protein.
- Buffalo milk also contains high levels of the natural antioxidant tocopherol.
- Buffalo milk is a suitable alternative for people with allergy to cow milk.
- In spite of higher fat%, the cholesterol content of buffalo milk Mozarella cheese (1562 mg) is lower than its cow milk counterpart (2287 mg) (Singh and Hussain, 2010).

6.1 Infant Foods

Buffalo milk is reported more suitable for infant feeding formulations for a number of beneficial aspects:

- Higher taurine content in buffalo milk (59 moles/litre) compared to (41.4 moles/litre) cow milk is considered beneficial for infant because of its beneficial role in the absorption of fat.
- Lower concentration of Urea (20 mg/100 ml) in buffalo milk as compared to cow milk (38 mg/100 ml) make buffalo milk suitable for infant food formulation.
- Due to higher level of lactoferrin in buffalo milk (320 mg/litre) as compared to 150 mg/litre in cow milk the associated antimicrobial properties render buffalo milk more suitable for preparation of infant food.
- Buffalo milk is richer in calcium and phosphorus, and lower in sodium and potassium than cow milk rendering buffalo milk a better choice for infant feeding.

6.2 Milk Processing

Buffalo milk is better suited for the manufacture of fat rich dairy products as compared to cow milk due to its higher fat, bigger size of the globule and higher proportion of solid fat leading to the higher yield, lesser loss of fat in butter milk or skim milk, easier preparation of cream or butter and better texture. Buffalo milk is commercially more viable than cow milk for the manufacture of fat-based and SNF-based milk products, such as butter, ghee, and milk powders because of its lower water content and higher fat content. Yoghurts are natural thick set without having -
Table 4: Milk production from different species in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Milk, whole fresh buffalo</th>
<th>Milk, whole fresh cow</th>
<th>Milk, whole fresh goat</th>
<th>Milk Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>15.68</td>
<td>11.97</td>
<td>0.86</td>
<td>28.50</td>
</tr>
<tr>
<td>1997</td>
<td>38.71</td>
<td>29.13</td>
<td>3.04</td>
<td>70.88</td>
</tr>
<tr>
<td>2003</td>
<td>47.98</td>
<td>34.97</td>
<td>3.71</td>
<td>86.66</td>
</tr>
<tr>
<td>2007</td>
<td>56.63</td>
<td>46.82</td>
<td>4.48</td>
<td>107.93</td>
</tr>
<tr>
<td>2012</td>
<td>67.68</td>
<td>59.81</td>
<td>4.95</td>
<td>132.43</td>
</tr>
</tbody>
</table>

Source: FAO Stats, Figures of milk are in Million Metric Tons per Year.

Table 5: Buffalo milk is the obvious choice for the following Indian products

<table>
<thead>
<tr>
<th>Milk Products</th>
<th>Processing advantages of buffalo milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khoa</td>
<td>It is a base for a wider range of mithais including gulabjamun, burfi, peda, kalakand, rabri, kulfi and their variants. Khoa from buffalo milk is considered distinctly superior, being whiter in color and having smooth body and granular texture.</td>
</tr>
<tr>
<td>Paneer</td>
<td>Buffalo milk paneer has all the good attributes of whitish, sweetish, mildly acidic, nutty flavour, spongy body and close knit texture.</td>
</tr>
<tr>
<td>Fermented milk products</td>
<td>Dahi and Shrikhand are popular fermented products where buffalo milk is preferred. Traditional milk products: It is estimated that about 50% of total milk produced in India is converted into traditional milk products.</td>
</tr>
</tbody>
</table>

Table 6: Cattle and buffalo population and annual milk production

<table>
<thead>
<tr>
<th>Year 2012</th>
<th>Total buffalo population</th>
<th>Total Cattle population</th>
<th>Total female buffaloes</th>
<th>Total female cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (millions)</td>
<td>108.70</td>
<td>190.90</td>
<td>92.60</td>
<td>122.98</td>
</tr>
<tr>
<td>Average Annual Milk Production (Kgs per annum per animal)</td>
<td>622.58</td>
<td>313.27</td>
<td>730.84</td>
<td>486.28</td>
</tr>
</tbody>
</table>

to add milk proteins or gelling agents as with milk of lesser milk solids. Higher innate levels of proteins and fat render buffalo milk a more economical alternative to cow milk for the production of casein, caseinates, whey protein concentrates and a wide range of fat-rich dairy products. Proteins of buffalo milk, particularly the whey proteins are more resistant to heat denaturation as compared to the cow milk protein. Dried buffalo milk may be preferred over dried cow milk for those technological applications where higher levels of un-denatured whey proteins would be more desirable. Buffalo Mozzarella is different from other types of Mozzarella because of its typical texture and juicy consistency.

Buffalo cream churns much faster at higher fat levels and gives higher overrun than cow cream. Due to the bigger size of globules and higher proportion of solid fat in buffalo milk, the separation of the cream and the churning of the cream is easier and the loss of fat in skimmed milk and buttermilk is far less. Buffalo milk produces butter with a significantly higher yield due to its higher fat content compared to cow milk. Further, in keeping quality tests, butter from buffalo cream displayed more stability than that from cow cream, due to the more solid fat and slower rate of fat hydrolysis in the former cream. This might explain why during storage, cow milk fat is more vulnerable to hydrolytic rancidity. The texture of buffalo ghee is better than cow ghee due to its bigger grain size, which, in turn, may be due to a higher proportion (9-12 percent) of high melting triglycerides compared to only about 5 percent in cow milk fat (Patil and Nayak, 2003).

The high fat content of buffalo milk makes it suitable for processing. The production of 1 kg of butter requires 14 kg of cow milk against 10 kg of
buffalo milk (Singh and Hussain, 2010). To produce one kg of Domiati cheese, a cheese maker requires 8 kg of buffalo milk, which lead to lower cost for the manufacture of the cheese (Hofi, 2010). The average yield of pindi khoa from standardized cow milk (fat 4.0% and SNF 8.6%) should be 18.5% and from buffalo milk (fat 6% and SNF 9%) 23% i.e for 1 kg khoa 5.4 kg cow milk is required but only 4.3 kg buffalo milk. Buffalo milk is the obvious choice for the following Indian products (Table 5).

7. Buffaloes Help in Reducing Carbon Footprint

As per the 19th Livestock Census of India held in 2012, the total buffalo population was 109 million compared to 191 million cattle population (Table 6). If we take the average milk production (Table 6), which clearly indicates that less numbers of buffaloes are required to produce the same amount of milk. Bovines are known to be a significant contributor to the global greenhouse gases (GHG) and when we produce more milk from less number of buffaloes as compared to cows, we help in reducing the carbon footprint. It is more pronounced, as unproductive buffaloes go for buffalo meat processing and help reduce the carbon footprint.

References


8. Conclusions

Buffaloes as a species are the obvious choice for the dairy farmers of India. They not only give more milk than the indigenous cows, but their milk is richer in nutrition in the form of proteins and fat. This helps in improving the nutritional status of millions of Indians. Since more than 29% Indian population have some nutritional deficiency, therefore the high nutrients from buffalo milk, go a long way to reduce this deficiency. Buffaloes are hardy animals, have resistance to heat stress and diseases caused by ticks etc, and moreover they are better convertors of coarse feed stuff, thus during its lifetime, buffalo is much more profitable than the indigenous cows. Apart from milk, buffaloes (male) are utilized for providing cheap draft power and at the end of the productive cycle, buffaloes fetch the farmers good returns to buy new buffalo. The spent buffaloes are utilized by the meat export houses. Their hides are used by the leather industry. Therefore buffaloes have become the obvious choice of farmers as they give better returns, they are obvious choice for the consumers as its milk has better nutrition, and in the end they help in sustaining environment by giving better production at expense of meagre resources. They also help in growth of the meat and leather sector in India and in turn these sectors contribute for increased productivity and sustained returns to farmers.


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