SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)
ISSN (Print) 1813-1743, ISSN (online) 2791-0547
Vol. 55:01 (2023).
Doi: https://doi.org/10.26692/surj-ss.v55i01.4464

Influence of Water Sources on Yield and Composition of Kundhi Buffalo Milk

MARIYAM KHALID[1], HUMA RIZWANA[1], GHULAM SHABIR BARHAM[2], ATIQUE AHMED BEHAN[1], NOOR-UN-NISA MARI[1], GUL BAHAR KHASKHELI[2], MUHAMMAD NAEEM RAJPUT[1], MEMOONA KHALID [1] AND KHALIQUE DINO MAHESAR[1]

[1]Department of Livestock Management, Sindh Agriculture University Tandojam.
[2]Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam.

Cite this:
Mariyam K., H. Rizwana, GS Barham, AA Behan, NN Mari, GB Khaskheli, MN Rajput, M Khalid, KD Mahesar (2023). Influence of water sources on yield and composition of Kundhi Buffalo milk. Sindh Uni. Res. J. (SS)

Corresponding author
gsbarham@sau.edu.pk

Abstract

Current study was conducted to observe the influence of canal water and ground water on the milk production and its physico-chemical attributes of Kundhi buffalo at the Milk Ocean Dairy Farms Gaddap Town Karachi and Department of Livestock management, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tando jam during the year of 2020. Twenty (n=20) lactating Kundhi buffaloes of same parity and lactation stage were selected, and divided in to two groups. Group-1 offered with canal water and group-2 watered with ground water. The average per time milk yield of Kundhi buffalo offered canal water was recorded significantly ($P<0.05$) higher than buffalo watered with ground water. Milk pH was numerically varied in both groups, while density noted notably ($P<0.05$) higher in milk of Kundhi buffalo directed with canal water compared to ground water. Milk protein, fat, lactose, total solids and solid not fat contents were found significantly ($P<0.05$) higher in milk of Kundhi buffaloes offered canal water than drunk ground water. In vice versa, total salt contents were noted comparatively ($P<0.05$) higher in milk of Kundhi buffaloes offered ground water than animals drunk canal water. It is concluded from the results of the study amongst both source of drinking water, canal water could be a better choice of to be offered as drinking water for Kundhi buffaloes to improve their production potential, nutritional quality of the milk.

Keywords: Kundhi buffalo, canal & ground water, milk yield & nutritional quality

INTRODUCTION

There are 180 million heads of water buffaloes *(Bubalus bubalis)* are habituated around the world, near about 97% population of buffalo is found in Asia continent. These animals have an excellent potential to convert low value forages into premium quality products and bi-products (Deb *et al.*, 2016). In Pakistan buffalo is considered to be the one of the most important dairy animals among all the other dairy animals, currently it produced 38,363 (000) of the milk, which contributes about 62% of the total milk production of the country (GOP, 2020-21). Almighty blessed the country with excellent breed potential of buffaloes in shape of Kundhi, Nili Ravi and Aza Kheli breeds (Khan *et al.*, 2007). These animals are being a major source of milk, meat, hide and skin, respectively. Without any doubt the buffalo milk is an excellent natural mammary secretion full of essential amino acids, saturated and unsaturated fatty acids, high profile minerals, energetic carbohydrates and valuable fat- and water-soluble vitamins, when its milk is compared with cow, sheep, goat and camel milk (Barłowska *et al.*, 2011).

Due to high nutritious worth and fat globule larger size of buffalo milk, it is the best choice for the manufacturing of fat-rich dairy products (Mane and Chatli, 2015). For the better growth of milking animal nutrients play a significant and vital role, though the protein and energy are considered to be the two most essential components for dairy animal's ration.

On the other hand, the availability of adequatequantity of water must also be ensured tomeet the bodily requirements of the dairy animals for the proper utilization of thefeed constituents in the body. It is a vital component of the body and isfacilitate various physiologicalmechanisms; ionic balance, digestion, absorption, metabolism, heat balance, elimination of waste productsfrom the body, intra- and extra-cellular nutrientstransport and electrolytes balance and it also provides afluid environment for developing fetus (Reece, 2005). Animal growth and production is directly influenced by both factors afford feed and water intake, usually for the better milk yield and production. Lactating animals required bulk quantity of potable water because they are quite susceptible to water quality and like to be drink contamination free clean water (Schutz, 2012). Sum of inorganic mater liquefy in water (Total dissolved solids) are considered to be the main decisive factor in evaluation of drinking water quality afford to the domesticated animals. Higher concentration of organic minerals *i.e*., sodium, potassium, copper, magnesium, iron, arsenic and sulfur in drinking water of lactating animals resulting imbalances the mineral metabolism in body, which adversely influences the milk yield and quality (NRC, 2001). Keeping in the view the above facts related with water, it is essential to highlight the merits of good quality potable waterfor dairy animals under a practical environment. In this context limited findings were found on the impact of different water sources onthe yield and milk quality of dairy Kundhi buffalo.

MATERIALS AND METHODS

The current work was designed to evaluate the effects of different water sources on the milk production and composition of Kundhi buffalo.

Experimental Design

The proposed work was designed to find-out the impact of water sources on milk yield and composition of Kundhi buffalo. A dairy farm namely Milk Ocean Dairy Farm Gaddap Town Karachi was selected for this research work and all the milk quality tests were performed in the laboratory of Milk Ocean Dairy Farm Karachi and Analytical laboratory of Department of Animal Products Technology.

Experimental animals

Twenty (n=20) freshly parturated lactating Kundhi buffaloes of same parity and lactation stage were selected for the experimental trial. The experimental animals were tagged, equally divided in to two groups (group-1& group-2) and managed under hygienic and well-ventilated environment. Kundhi buffaloes of Group-1were offered canal water, where Group-2 animals were directed with ground water. Both groups of Kundhi buffalo were directed with canal and ground water for the period of six (6) months.

Table-1 Quality evaluation of canal and ground water used for research experiment.

Variables	Sources of drinking water	
	Canal water	Ground water
pH	7.9	7.1
EC (dS/m)	0.36	4.46
TSS (ppm)	230	2854
Ca + Mg	2.3	17.6
Na	1.2	22.3
K	0.1	0.8
Carbonate (CO_3)	0	0
Bicarbonate (HCO_3)	0.4	6.2
Sulfate (SO_4)	2	11.2
Chloride (Cl)	1.2	27.2
SAR	1.1	7.5
Source: Fuji Fertilizer Company Limited (FFC)		

Water sampling

Water (canal and ground water) samples were collected from the water available for drinking to animals of each group at the selected dairy buffalo farms. One liter of water sample taken in a labeled plastic bottle from each category, were analytically evaluated from the Laboratory of the Fuji Fertilizer Company Limited Tandojam and mentioned in Table-1.

Milk sampling from farm animals

Milk samples were collected from each Kundhi buffalo of both groups and offered canal and ground water at the selected dairy farms. 500ml volume of each milk sample was collected in the labeled sterile bottle in hygienic cooled conditions (4°C), were brought to the analytical laboratory of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam for analysis purpose.

Milk yield

Milk yield of both groups (1 and 2) of Kundhi buffalo watered with canal and ground water were recorded and documented on daily basis.

Milk composition

Physico-chemical attributes of Kundhi buffalo milk samples were analyzed by using following standard protocols.

Physical quality characteristics

pH value

100 ml volume of mixedmilk sample was poured into a beaker and electrode and thermometer probe of pH meter meter (Model DIST-3 and Hl, Hanna Instruments, Italy) was inserted in to sample. Appeared reading on the screen of pH meter was noted as pH value of milk sample (AOAC, 2005).

Density

By adjusting temperature of milk sample at 60°F it was poured in to measuring cylinder followed by Queen's Lactometer was inserted in to milk sample. Lactometer was allowed to float and settled in the milk then reading was noted on the scale of the lactometer. Similarly at the same time the temperature of the milk was also noted by using thermometer. In this regard the lactometer value was computed for estimating the density of milk by using following formula (AOAC, 2005).

$$Density = \frac{Corrected\ lactometer\ reading}{1000} + 1$$

Chemical quality characteristics

Lacto-scan milk analyzer (Model: FT-IR Perkin Elmer Engineering Limited, USA) was used to analyze each milk sample for the chemical quality evaluation. Initially the Lacto-scan milk analyzer was calibrated with the reference ranges of milk constituents as mentioned in Table-2.

Table-2. Reference values of milk constituents used for Lacto-scan milk analyzer calibration.

Milk variables	Reference ranges
Fat	0-13 %
Protein	0-6 %
Lactose	0-6 %
Ash	0-2%
Total solids	0-25 %
Solid not fat	0-13%

Milk analysis protocol by using Lacto-scan milk analyzer

10ml homogenized milk sample was preheated at 38°C, loaded in the flow pump system of the Lacto-scan milk analyzer and after 45seconds reading values regarding fat, protein, lactose, ash, total solids and solid not fat contents were observed on the screen of the milkanalyzer and values of milk constituents were recorded accordingly (Barham, 2018).

Statistical analysis of data

Computerized statistical package of Student Edition of Statistix (SXW), version 8.1 (Copyright 2005, Analytical software, USA) was used to analyzed the gathered tabulated data. For observing the statistical variation in the average values of data, ANOVA and Tukey's tests were performed at 0.05 probability levels.

RESULTS AND DISCUSSION

Milk yield of Kundhi buffalo

The average milk yield (5.87±0.066 liters per time) of Kundhi buffalo offered canal water was recorded comparatively ($P<0.05$) higher compared to similar type of buffalo (5.22±0.131liters/time) watered with ground water (Figure-1). Correspondingly, daily average milk production was recorded relatively high in Nili Ravi buffalo directed with canal water compared to turbine water by Tausif *et al.* (2018). The production potential of lactating animals resulting with thebetter management, availability of feed ingredients and resources of drinking water. Similarly, significant ($P<0.05$) increase in dairy productivity of about 17% was seen by Guadalupe *et al.* (2015) in lactating dairy animals that burned through switch osmotic desalinated drinking water. Thus, it can be possible by means of the provision of adequate clean and palatable water to dairy animals is of prime importance for better production (Valtorta *et al.*, 2008). As per recommendation of the National Research Council (2001) for the good health and better production of the dairy animals 5000mg/L of total dissolved salts in water are quite satisfactory, while beyond the critical limits of suspended salts in water (>7000 mg/L) should be risk factor for animal health and its production potential.

Physical quality characteristics of Kundhi buffalo milk

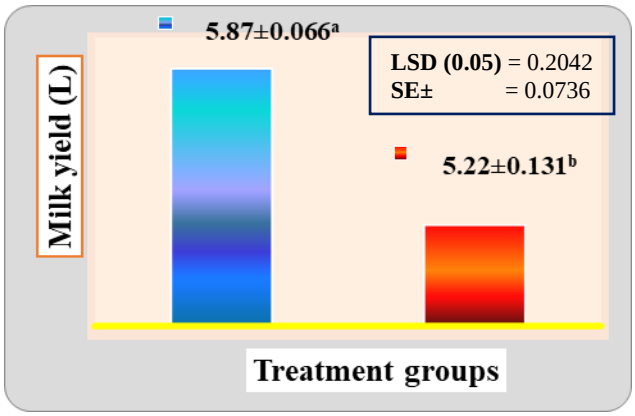

Figure 1. Milk yield (Liters/time) of Kundhi buffalo directed with canal and ground water.

pH value and Density

The average pH values (6.67 and 6.70) of Kundhi buffalo milk directed with canal and ground water were numerically varied, while specific densities (1.033 and 1.030 was noted significantly (P<0.05) higher in milk of Kundhi buffalo directed with canal water compared to ground water (Table-3). In accordance, in all the milk samples of buffalo found 6.59 to 6.93 pH and 1.027 to 1.029 densities with slight variation (Rehman and Salariya, 2005). The variation in the pH and density of Kundhi buffalo milk might be due to the concentration of water in milk and pH varied due to the acidity and alkalinity. In another study 6.38 to 6.77 pH values were documented by the panel of scientists in the milk of the buffalo (Imran *et al.,* 2008). The normal ranges of pH of buffalo milk (6.57 to 6.84) and density (1.031 to 1.034) are mainly influenced by so many factors like, lactation, season, correlated with solid-not-fat, fat, lactose contents, feed ingredients and supply of drinking water (Han *et al.,* 2012).

Table-3. Physical characteristics of Kundhi buffalo milk offered canal and ground water.

Physical variables	Water treatment groups of Kundhi buffalo	
	Canal water	Ground water
pH value	6.67±0.025	6.70±0.058
Density	1.033±0.008[a]	1.030±0.008[b]
LSD (0.05) =	**0.0012**	
SE± =	**0.0004**	

Chemical quality characteristics of Kundhi buffalo milk

As concerned with current results regarding the chemical attributes of Kundhi buffalo milk offered with canal water, protein, fat, lactose, total solids and solid not fat contents (4.50±0.041, 6.75±0.065, 4.75±0.029, 16.80±0.074 and 10.05±0.051%) were recorded remarkably (P<0.05) higher compared to milk (4.08±0.048, 5.75±0.064, 4.47±0.048, 15.22±0.066 and 9.47±0.052%) of Kundhi buffalo watered with ground water, except total salt contents were found higher in milk(0.80±0.008%) of Kundhi buffalo watered with ground than canal water (0.92±0.008%), respectively (Table-4). In favor of current results Tausif *et al.* (2018) recorded highest values of fat and solid not fat contents except total minerals in the milk of Nilli Ravi buffalo offered canal water compared to that of similar animals directed with turbine and/or ground water. Likewise, better fat, protein and lactose concentrations were recorded in the milk of animals drinking salt free water as compared to milk of those who were drinking saline brackish water (Solomon *et al.,* 1995). In addition, similar trend of results for fat content in were documented by Revelli *et al.* (2005) in milk of animals those offered low salt water.In the current results higher concentration of total salt and lower percent of total solid contents in Kundhi buffalo offered ground water is might be due to the drinking of salty water the noteworthy quantity of absolute degradation of salts had a danger of delivering milk fat sadness relatively multiple times more than that of lactating animals drank with low total dissolved salt water (Guadalupe *et al.,* 2015). Moreover, the mineral constituents in the feeding routine source of drinking water could directly affected on the weakening proportion of feed in the rumen, decreased aging of fiber and some metabolite forerunners of fat and protein mix in the milk (Beede, 2006).

Table-4 Chemical characteristics of Kundhi buffalo milk offered canal and ground water.

Chemical variable (%)	Water treatment groups of Kundhi buffalo	
	Canal water	Ground water
Protein	4.50±0.041	4.08±0.048
Fat	6.75±0.065	5.75±0.064
Lactose	4.75±0.029	4.47±0.048
Ash	0.80±0.008	0.92±0.008
Total solids	16.80±0.074	15.22±0.066
Solid not content	10.05±0.051	9.47±0.052
***P- value = <0.05**		

CONCLUSION

Findings of the current study were helpful for the commercial dairy farmers for the selection of best quality water source (canal water with 230ppm total suspended salt) which efficiently enhanced the yield and nutritional quality of buffalo milk. Nevertheless, this study has also provided guidelines to the dairy farmers for safe use of drinking water in predicament localities as ground and/or salted water not only affects the productive performance, but the health of buffaloes is also compromised.

ACKNOWLEDGEMENT

Authors are very much thankful to the Department of Livestock Management and Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University

Tandojam, Fogi Fertilizer Company and Milk Ocean Dairy Farms, Gaddap Town Karachi for the facilitation and completion of this research work.

CONFLICT OF INTEREST

All the authors have no any conflict of interest regarding the publication of this article.

REFERENCES

Deb, G., T. Nahar, P. Duran, and G. Pressice. 2016. Safe and sustainable traditional production: The water buffalo in Asia. *Front. Environ. Sci.* 38, 1-7.

GOP, 2020-21. Economic Survey of Pakistan. Economic Advisor Wing Ministry of Finance, Government of Pakistan, Islamabad.

Khan, M.S., N. Ahmad and M.A. Khan. 2007. Genetic resources anddiversity in dairy buffaloes of Pakistan. *Pak. Vet. J*. (27): 201-207.

Barłowska, J., M. Szwajkowska, Z. Litwinczuk and J. Krol. 2011. Nutritional value and technological suitability of milk from various animal species used for dairy production. *Compr. Rev. Food Sci. Food Saf.*,10, 291-302.

Mane, B.G. and M.K. Chatli. 2015. Buffalo Milk: Savior of Farmers and Consumers for Livelihood and Providing Nutrition. *Agricultural Rural Development*, 2, 5-11.

Reece, W.O. 2005. Functional anatomy and physiology of farmanimals. 3rd Edition, Philadelpia, PA, USA: Lippincott Williams &Wilkins; 2005.

Schutz, K. 2012. Effects of providing clean water on the health and productivity of cattle. Report for NRC, (400): 346.

NRC, 2001. Nutrient requirement of dairy cattle. 7th Review Edition.National Academy Press, Washington, DC, USA.

AOAC, 2005. Official methods of analysis of theassociation of official analytical chemists. Inc. Gaithersburg, U.S.A.

Barham, G.S. 2018. Adulterations and their impact on quality characteristics of milk. Chapter-III; Materials and Methods. Physico-chemical evaluation of raw milk. Thesis submitted to the Sindh Agriculture University Tandojam, p: 16-45.

Tausif, M.A., S.H. Faisal, J.A. Bhatti, S. Qamar, A. Khalique, H. Rahman, H.M. Ali, and A. Hussain. 2018. Effect of water quality on production performance of lactating Nili-Ravi buffaloes. *Turk. J. Veter. and Anim. Sci.*, (42): 543-548.

Guadalupe, G.M. Jose, C.D. Herrera-Monsalvo, A. Lara-Bueno, R. Lopez-Ordaz, J.J. Jaimes and R. Ramirez-Valverde. 2015. Effects of drinking water desalination on several traits of dairy cows in a Mexican semiarid environment. *Life Sci. J*. (12): 83-97.

Valtorta S.E., M.R. Gallardo, O.A. Sbodio, G.R. Revelli, C. Arakaki, P.E. Leva, E.J. Gaggiotti and M. Tercero. 2008. Water salinity effectson performance and rumen parameters of lactating grazingHolstein cows. *Inter. J. Biometeorol*. (52): 239-247.

Rehman, Z. U. and A.M. Salariya. 2005. Effect of storage conditions on nutritional quality of UHT processed buffalo milk. *J. Chem. Soci. Pak.*, 27(1): 73.

Imran, M., H. Khan, S.S. Hassan and R. Khan. 2008. Physicochemical characteristics of various milk samples available in Pakistan. *J. Zhej. Univer. Sci. B*, 9(7): 546-551.

Han, X., Lee, F. L., Zhang, L. and M.R. Guo. 2012. Chemical composition of water buffalo milk and its low-fat symbiotic yogurt development. *Funct. Foods in Health and Dis.*, 2(4): 86-106.

Solomon, R., J. Miron, D. Ben-Ghedalia and Z. Zomberg. 1995. Performance of high producing dairy cows offered drinking water of high and low salinity in the Arava desert. *J. Dairy Sci*., 78(3): 620-624.

Revelli G.R., O.A. Sbodio, M.R. Gallardo, S.E. Valtorta and E.J. Tercero. 2005. Performance of dairy cows of low production in pastoral conditions with salt or desalinated drinking water supply. *Manag. Fave. Sec. Sci. Vet.* (4): 77-88.

Beede, D.K. 2006. Evaluation of water quality and nutrition for the dairy cattle. In: Proceedings of High Plains Dairy conference. Albuquerque, NM, USA, 2006. pp. 1-24.