EFFECT OF SEASON AND STAGE OF LACTATION ON MILK COMPONENTS IN PURNATHADI BUFFALOES

Prajakta Kuralkar[1,]*and Shailendra Kuralkar[2]

Received: 20 January 2020
Accepted: 19 September 2022

ABSTRACT

The present study was designed to observe the effect of season and stage of lactation on milk components of Purnathadi buffaloes. Total 346 milk samples were collected, from three different seasons (winter, summer and rainy) and stage of lactation (early, mid and late) for the study. Overall milk fat, protein, lactose, solid not fat (SNF) and total solids (TS) were observed as 8.44±0.07, 3.99±0.02, 3.96±0.02, 8.78±0.04, and 17.23±0.08% respectively. There was significantly higher fat and total solids percent during winter (9.01±0.23 and 17.62±0.26% respectively) and lower during summer (8.25±0.14 and 16.73±0.14% respectively) season, but milk SNF percent was significantly higher during rainy (9.00±0.04%) and lower during summer (8.48±0.05%). Stage of lactation had also significant effect on milk components; milk fat, protein, SNF, and TS percent increased significantly with the advancement of lactation stage, whereas milk lactose was nonsignificant. Milk fat during early, mid and late lactation was 7.43±0.10, 8.40±0.07 and 8.79±0.12%; protein was 3.83±0.06, 3.94±0.02 and 4.06±0.02%; SNF was 8.36±0.14, 8.70±0.04 and 8.96±0.05% and TS was 15.61±0.17, 17.10±0.08 and 17.75±0.12%, respectively. Thus, results of the present investigation indicated that season and stage of lactation affect certain milk components in Purnathadi buffaloes and could be minimized by better farm management practices.

Keywords: *Bubalus bubalis*, buffaloes, Purnathadi buffalo, lactose, fat, total solid, solid not fat, stage of lactation

INTRODUCTION

India is a rich repository of bubaline genetic resource. Buffaloes are well adapted to a hot and hot humid climate and play an important role in the agricultural production system-based economy of Indian farmers (FAO, 2005). In India buffalo population is 109.85 million out of which Maharashtra state has 33 million. About 20.5% of the total livestock is contributed by buffaloes (Livestock Census, 2019). The buffalo is the major dairy animal in India, contributing approximately 49.2% of the total milk produced in the country (Annual Report 2017 to 2018). Milk provides essential nutrients and is an important source of

[1]Department of Veterinary Physiology, Institute of Veterinary and Animal Sciences, Akola, India, *E-mail: pskuralkar@rediffmail.com

[2]Department of Animal Genetics and Breeding, Institute of Veterinary and Animal Sciences, Akola, India

dietary energy, high-quality proteins, and fats.

Purnathadi - locally known as 'Bhuri buffaloes,' is a prominent milch animal of Akola district of Maharashtra. In Purnathadi buffaloes the lactation length ranges from 210 to 255 days with lactation milk yield ranging from 800 to 1000 kg/lactation (Ali *et al*., 2019). Purnathadi buffalo is well known for its regular breeding and high milk fat content (Baglane *et al*., 2008). Certain milk component decides the milk price in the market and thereby affects the economic condition of dairy farmers and also economy of milk production (Boro *et al*., 2018). Milk composition analysis helps in monitoring the nutritional management of buffalo secreting low quality milk. Literature is abundant regarding average buffalo milk composition but information on the seasonal variations and stage of lactation in composition of buffalo milk is scanty. In this context, the study was aimed to determine the effects of season and stage of lactation on the milk composition of Purnathadi buffaloes.

MATERIALS AND METHODS

The present study was carried out at Purnathadi Buffalo Unit, Post Graduate Institute of Veterinary and Animal Sciences, Akola (Maharashtra) throughout the year during 2016. Buffaloes were maintained in loose housing system of management and hand milking was practiced at 5.00 am and 5.00 pm daily. The buffaloes were fed adlibitum amount of seasonal green and dry fodder and mixture of cottonseed cake, ground maize. For milk let down, suckling of calf was practiced. A total of 346 milk samples were taken from Purnathadi buffaloes during different seasons (winter, summer and rainy) and different lactation stages (early, mid and late). Milk samples were analyzed for different milk components such as fat, protein, lactose, SNF, TS and salts using milk analyzer "LACTOSCAN" (New Dairy Engineering and Trading Company Pvt. Ltd., Delhi, India).

RESULTS AND DISCUSSION

The effect of season and stage of lactation on milk components of Purnathadi buffaloes are presented in Table 1 and Table 2, respectively. The graphical representation of effect of season and stage of lactation on milk components of Purnathadi buffaloes is given in Figure 1 and Figure 2, respectively.

In the present study the overall average fat percent observed in Purnathadi buffalo milk was 8.44±0.14% which was in close agreement with that reported in Surti buffaloes (Kapadia *et al*., 2016) and higher than present in other buffalo breeds like Murrah and Nili-Ravi buffaloes (Zhou *et al*., 2018); Bhadawari, Mehsana, Murrah and Surti buffaloes (Misra *et al*., 2008); non-descript and graded Murrah buffaloes (Balusami, 2015) and lower than present in Toda buffaloes (Jothi *et al*., 2017). The effect of season on milk fat percent was significant with higher value in winter milk (9.01±0.23%) than summer milk (8.25±0.14 %), similar results are also noted in Murrah buffaloes (Pawar *et al*., 2012); Murrah, Nilli-Ravi and Jaffrabadi buffaloes (Ahmad *et al*., 2013) and in raw buffalo milk samples (Yasmin *et al*., 2012). In contrary significant decrease in fat percent in winter and increase during summer was observed by Yadav *et al.* (2013) in Murrah buffaloes, whereas Patbandha *et al.* (2015) reported non-significant effect of season on milk fat in Jaffarabadi buffaloes. The higher values of fat percent in winter might be due to availability of fresh green pasture feed

and dry forage in summer. The effect of stage of lactation on milk fat percent was significant in the present study with increasing trend from early to late lactation (7.43±0.10%, 8.40±0.07% and 8.79±0.12%). Similar significant variation in fat content of milk in various stage of lactation was also reported by Garaniya *et al*. (2013); Sahin *et al*. (2016) in Jaffarabadi and Anatolian water buffaloes respectively, whereas Thakore and Jain (2018) reported reverse trends.

The overall average Protein percent in present study was observed as 3.99±0.02% which was in agreement with the finding of Kanwal *et al*. (2004) in local buffalo; Khan *et al*. (2007) in water and swamp buffaloes; Misra *et al*. (2008) observed in Bhadawari, Mehsana, Murrah and Surti; Khosroshahi *et al*. (2011) in Iranian buffaloes and higher values than that reported in Murrah buffaloes (Meena *et al*., 2007) and lower than that reported in Murrah and Nili-Ravi buffaloes (Zhou *et al*., 2018); Jaffrabadi buffaloes (Patbandha *et al*., 2015); non-descript and graded Murrah buffalo (Balusami, 2015). The protein content of summer, rainy and winter season milk statistically did not show any significant difference (P>0.05), however, the protein contained in rainy season milk was higher than winter and summer season milk. Khosroshahi *et al*. (2011); Nateghi *et al*. (2014) also reported non-significant season effect on protein composition of milk. In contrary, Patbandha *et al*. (2015) reported significantly higher protein percent during summer and lower during winter season in Jaffrabadi buffaloes, whereas, Yadav *et al*. (2013) reported significantly increased protein level during winter season in Murrah buffaloes. In the current study, the stage of lactation was a significant source of variation on protein percent with increasing trend from early to late lactation (3.83±0.06, 3.94±0.02 and 4.06±0.02%). Sahin *et al*. (2016) have also determined that the stage of lactation had a significant effect on the protein content. Roy *et al.* (2003) and Garaniya *et al*. (2013) have reported that the stage of lactation did not have any significant effect on milk protein content.

The overall average Solid not fat (SNF) percent in this study was observed to be 8.78±0.04 which was found to be in agreement with the findings by Sharma *et al.* (1980) in Jafarabadi, Mehasana and Murrah buffaloes and by Kanwal *et al*. (2004) in local buffaloes. Whereas Zaman *et al*. (2007); Patbandha *et al*. (2015); Jothi *et al*. (2017) reported higher SNF % in swamp buffalo, Jaffarabadi and Toda buffaloes respectively. In the present study the season has significant effect on SNF content with highest value in rainy season (9.00±0.04%) and lowest in summer season (8.48±0.05%). These observations were in agreement with the findings from the studies of Bhonsle *et al*. (2003); Rao *et al*. (2010) in Murrah and local buffaloes, respectively, whereas Chandrakar *et al*. (2018) did not observed any significant effect of season on milk SNF content. The stage of lactation was found to be affecting the solid not fat of milk significantly with increasing trend from early to late lactation (8.36±0.14%, 8.70±0.04% and 8.96±0.05%, respectively) in the present investigation. Dubey *et al*. (1997); Sahin *et al*. (2016) reported similar findings in Murrah and Anatolian water buffalo, however Bhonsle *et al*. (2003), Patbandha *et al*. (2015); Chandrakar *et al*. (2018) did not observe any significant effect of stage of lactation on milk SNF content.

The overall average lactose percent observed was 3.96±0.02% which was close to the value that reported by Kanwal *et al*. (2004) and lower than that reported by Zhou *et al*. (2018) in Murrah and Nili-Ravi buffaloes; Yasmin *et al.* (2012); Yadav *et al*. (2013); Nateghi *et al*. (2014); Kapadia *et al*. (2016) in Surati buffaloes, Sahin *et*

al. (2016) in Anatolian water buffaloes; Khan *et al*. (2007) in water and swamp buffaloes; Khosroshahi *et al*. (2011) in Iranian buffaoes. In this study there was no significant difference regarding lactose content between summer (4.09±0.07%), rainy (3.95±0.02%) and winter (3.86±0.05%) season. Similar results were also observed by Dubey *et al.* (1997); Khosroshahi *et al.* (2011), whereas Bhonsle *et al*. (2003); Patbandha *et al*. (2015) reported significant effect of season on lactose content. The stage of lactation did not affect the lactose content of Purnathadi buffalo milk in the present study. Chandrakar *et al*. (2018) also observed that the stage of lactation had no significant effect on milk lactose %; however, Bhonsle *et al*. (2003); Patbandha *et al*. (2015) reported significant decline in lactose content with advancement of lactation stage. The main biological function of lactose in milk is the regulation of water content and thus the regulation of osmotic content (Davis *et al*., 1983; Jenness, 1985), because of this function lactose remains the most constant constituent in milk.

The overall average total solid (TS) percent was found to be 17.23±0.08% which was in line with the findings of Ahmad *et al*. (2013) in Murrah, Nili-Ravi, Jafrabadi buffaloes, Balusami (2015) in non-descript and graded Murrah buffaloes, Sodi *et al.* (2008) in Murrah buffaloes, Zhou *et al*. (2018) in Nili-Ravi buffaloes and Misra *et al*. (2008) in Bhadawari buffaloes. However, Zhou *et al*. (2018) reported higher values in Murrah buffalo, whereas lower values are reported by Misra *et al*. (2008) in Mehsana, Surti and Murrah buffaloes, Nateghi *et al*. (2014); Kanwal *et al*. (2004) in local buffaloes. The study revealed significant seasonal variation in total solid content of milk with higher value

Table 1. Effect of season on milk components in Purnathadi buffalo.

Parameters season (N)	Fat %	Lactose	Solid not fat	Protein	Total solid
Summer (85)	8.25±0.14^{b}	4.09±0.07	8.48±0.05^{b}	3.88±0.03	16.73±0.14^{b}
Rainy (185)	8.30±0.07^{b}	3.95±0.02	9.00±0.04^{a}	4.08±0.02	17.29±0.08^{ab}
Winter (76)	9.01±0.23^{a}	3.86±0.05	8.61±0.11^{b}	3.90±0.05	17.62±0.26^{a}
Pooled mean±SE	8.44±0.07	3.96±0.02	8.78±0.04	3.99±0.02	17.23±0.08
Significant/ nonsignificant	**	NS	**	NS	*
Critical difference	0.53	-	0.34	-	0.66

Table 2. Effect of stages of lactation on milk components in Purnathadi buffalo.

Parameter season (N)	Fat %	Lactose	Solid not fat	Protein	Total solid
Early lactation (57)	7.43±0.10^{c}	3.81±0.07	8.36±0.14^{c}	3.83±0.06^{c}	15.61±0.17^{c}
Mid lactation (117)	8.40±0.07^{b}	3.82±0.02	8.70±0.04^{b}	3.94±0.02^{b}	17.10±0.08^{b}
Late lactation (172)	8.79±0.12^{a}	3.94±0.02	8.96±0.05^{a}	4.06±0.02^{a}	17.75±0.12^{a}
Pooled mean±SE	8.44±0.07	3.88±0.02	8.78±0.04	3.99±0.02	17.23±0.08
Significant/ nonsignificant	**	NS	**	**	**
Critical difference	0.35	-	0.23	0.10	0.43

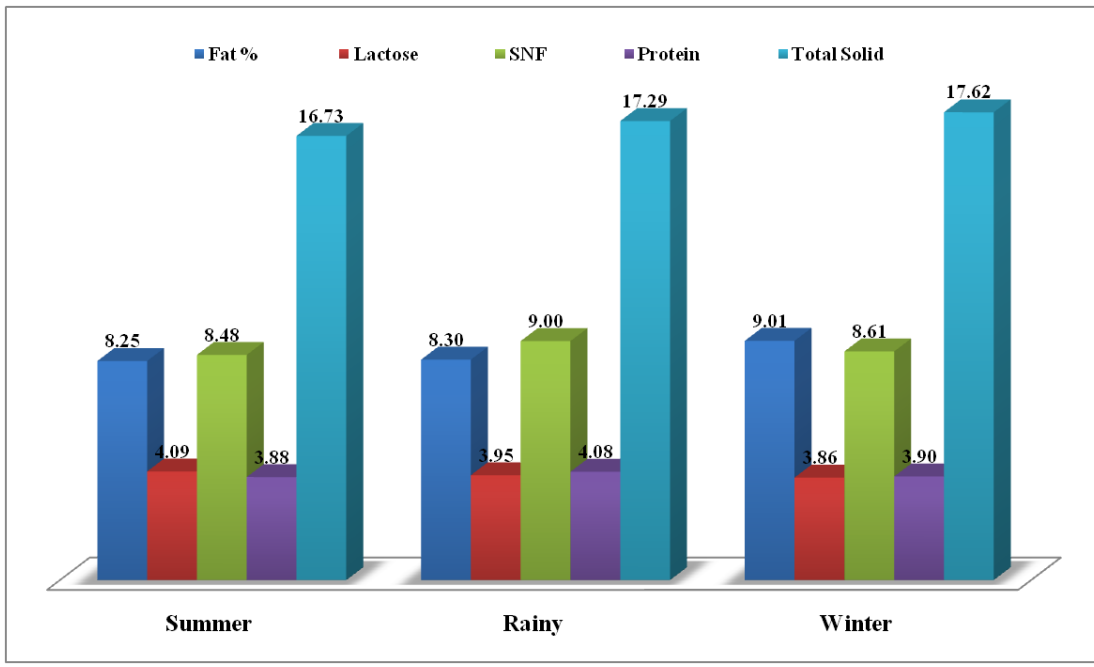

Figure 1. Composition of Purnathadi buffalo milk in different seasons.

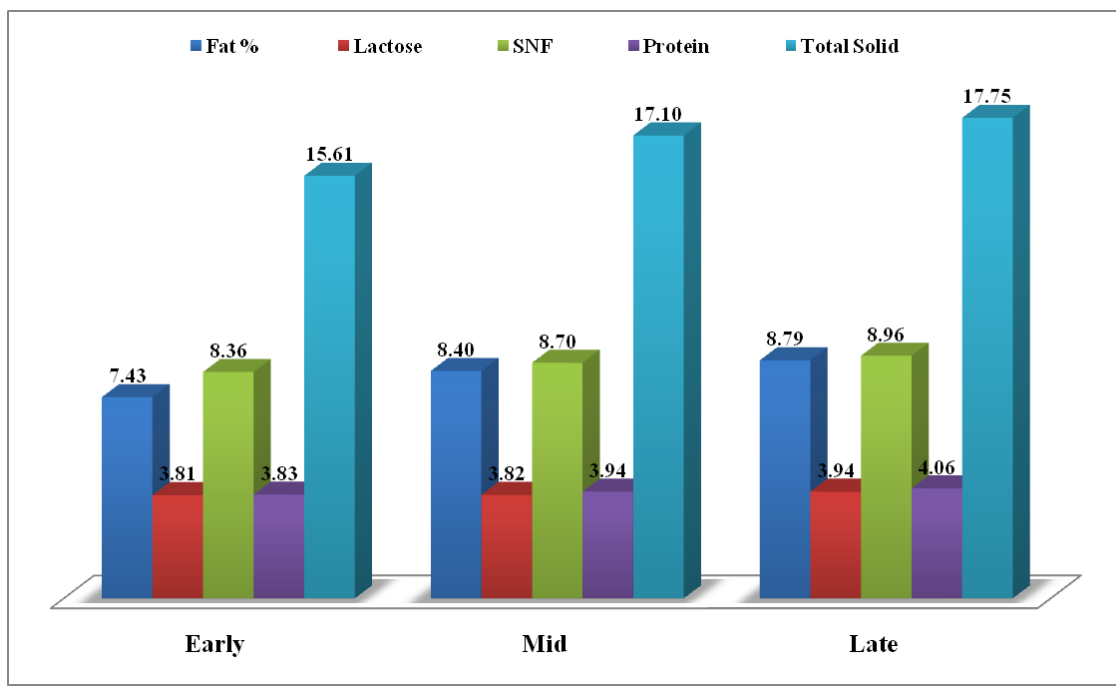

Figure 2. Composition of Purnathadi buffalo milk in different stages of lactation.

in winter (17.62±0.26%) and lower in summer (16.73±0.14%) season. In contrary Nateghil *et al.* (2014) reported significantly higher TS values during summer and lower during winter season. Whereas Patbandha *et al.* (2015) observed non-significant effect of season on TS with higher values during summer and lower during winter. In the present study a significant difference was observed in total solid content at different stage of lactation with increasing trend from early lactation to late lactation (15.61±0.17%, 17.10±0.08% and 17.75±0.12%). Bhonsle *et al.* (2003); Zaman *et al.* (2007) also observed a significant difference in the total solids percentage of buffalo milk due to the effect of stage of lactation, while, Patbandha *et al.* (2015) reported non-significant effect of stage of lactation on TS.

CONCLUSION

Results of the present study indicate that season and stage of lactation affect certain milk components in Purnathadi buffalo milk. The seasonal variation in milk constituents might be predominantly due to animal feeding. The different feed and fodder available in different season affect the nutrient availability to the buffalo thereby affect the milk composition. In winter animals feed on fresh pasture while in summer they feed on dry forage. Stage of lactation been a physiological process cannot be changed with managemental practices. Also, it can be concluded that variation in milk composition may be due to various other factors like Environment, climatic condition, nutritional and physiological status of the animal.

REFERENCES

20th Livestock Census. 2019. *Key Results.* Department of Animal Husbandry, Dairying and Fishereis. Ministry of Fisheries, Animal Husbandry and Dairying, New Delhi, India.

Ahmad, S., T. Zhang, F. Lee, Y. Liu, X. Li and M. Guo. 2013. Seasonal variations in chemical composition of buffalo milk. *Buffalo Bull.*, **32**(Special Issue 2): 1324-1329. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/286779

Ali, S.S., S.V. Kuralkar, M.V. Ingawale, S.P. Waghmare, S.J. Manwar, R.S. Kataria and V. Vohra. 2019. Phenotypic characterization, management and socio-economic impact of Purnathadi buffaloes. *Indian J. Anim. Sci.*, **89**(10): 1161-1166.

Baglane, B.B., D.R. Ambulkar, S.Z. Alil and S.S. Ali. 2008. Month and season of calving on production performance of Purnathadi buffaloes. *Indian Vet. J.*, **85**: 1237-1239.

Balusami, C. 2015. Milk constituents of non descript and graded Murrah buffaloes in Tamil Nadu, India. *Indian J. Natural Sciences*, **5**(28): 2475-2479. Available on: https://tnsroindia.org.in/JOURNAL/ISSUE%2028%20%20FULL%20TEXT%20PART%201.pdf

Bhonsle, D., S.K. Chourasia and M.J. Singh. 2003. Factors influencing major milk constituents in Murrah buffaloes. *Indian J. Anim. Sci.*, **73**(1): 107-109.

Boro, P., J. Debnath, T.K. Das, B.C. Naha, N. Debbarma, P. Debbarma, C. Debbarma, L.S. B. Devi and TG. Devi. 2018. Milk composition and factors affecting it in dairy buffaloes: A review. *Journal of Entomology and Zoology Studies*, **6**(3):

340-343. Available on: https://www.entomoljournal.com/archives/2018/vol6issue3/PartE/6-2-209-859.pdf

Chandrakar, C., P. Kumar, S. Shakya, S.K. Jaiswal, Monika, U. Wasist and S.S. Sahu. 2018. Physiochemical characteristics of buffalo milk samples available in four districts of Chhattisgarh, India. *International Journal of Current Microbiology and Applied Sciences*, **7**(2): 1992-1999. DOI: 10.20546/ijcmas.2018.702.238

Davies, D.T., C. Holt and W.W. Christie. 1983. The composition of milk. Ch. 5 *In* Mepham, B. and T. Amsterdam (eds). *Biochemistry of Lactation*, Elsevier, UK.

Dubey, P.C., C.L. Sumaw, M.K. Sanyal, H. Spandey, M.M. Saxena and P.L. Yadav. 1997. Factors affecting composition of milk of buffaloes. *Indian J. Anim. Sci*., **67**(9): 802-804.

FAO. 2005. *Buffalo Production and Research.* Food and Agriculture Organization, Rome, Italy.

Garaniya, N.H., H.R. Ramani and B.A. Golakiya. 2013. Nutrient profile of Jaffarabadi buffalo milk at different stages of lactation. *Journal of Dairy and Food Research*, **32**(2): 168-170.

Government of India. 2017-18. *Annual Report 2017-18*. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, India.

Jenness, R. 1985. Biochemical and nutritional aspects of milk and colostrum, p. 164-197. *In* Larson, B.L. and R.R. Anderson (eds). *Lactation*. Ames: Iowa State University Press, Iowa, USA.

Jothi, B., B. Allwin, N. Kumar, V. Pradeep and B.S. Nag. 2017. Physio - chemical qualities of the toda buffalo milk. *International Journal of Advanced Biological Research*, **7**(1): 132-134. Available on: http://www.scienceandnature.org/IJABR/IJABR_Vol7(1)2017/IJABR_V7(1)17-26.pdf

Kanwal, R., T. Ahmed and B. Mirza. 2004. Comparative analysis of quality of milk collected from buffalo, cow, goat and sheep of Rawalpindi/islamabad region in Pakistan. *Asian J. Plant Sci*., **3**(3): 300-305. DOI: 10.3923/ajps.2004.300.305

Kapadiya, D.B., D.B. Prajapati, A.K. Jain, B.M. Mehta, V.B. Darji and K.D. Aparnathi. 2016. Comparison of Surti goat milk with cow and buffalo milk for gross composition, nitrogen distribution, and selected minerals content. *Vet. World*, **9**(7): 710-716. DOI: 10.14202/vetworld.2016.710-716

Khan, M.A.S., M.N. Islam and M.S.R. Siddiki. 2007. Physical and chemical composition of swamp and Water buffalo milk: A comparative study. *Ital. J. Anim. Sci*., **6**(2S): 1067-1070. DOI: 10.4081/ijas.2007.s2.1067

Khosroshahi, Z.T., S.A. Rafat and D. Shoja. 2011. Effects of non-genetic factors in milk production and composition in east Azarbaijan native buffaloes of Iran. *Buffalo Bull*., **30**(3): 203-209. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/286345

Meena, H.R., H. Ram and T. Rasool. 2007. Milk constituents in non-descript buffaloes reared at high altitudes in the Kumaon hills of the centeral Himalayas. *Buffalo Bull*., **26**(3): 72-76. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/286153

Misra, S.S., Arjava Sharma, T.K. Bhattacharya, P.

Kumar and S.S. Roy. 2008. Association of breed and polymorphism of alpha S1- and alpha S2-casein genes with milk quality and daily milk and constituent yield traits of buffaloes (*Bubalus bubalis*). *Buffalo Bull*., **27**(4): 294-301. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/286200

Nateghi, L., M. Yousef, E. Zamani, M. Gholamian and M. Mohammadzadeh. 2014. The effect of different seasons on the milk quality. *European Journal of Experimental Biology*, **4**(1): 550-552. Available on: https://www.primescholars.com/articles/the-effect-of-different-seasons-on-the-milk-quality.pdf

Patbandha, T.K., K. Ravikala, B.R. Maharana, S. Marandi, A.R. Ahlawat and P.U. Gajbhiye. 2015. Effect of season and stage of lactation on milk components of Jaffrabadi buffaloes. *The Bioscan*, **10**(2): 635-638.

Pawar, H., G.R. Kumar and R. Narang. 2012. Effect of year, season and parity on milk production traits in Murrah buffaloes. *Journal of Buffalo Science*, **1**(1): 122-125. DOI: 10.6000/1927-520X.2012.01.01.22

Rao, A. and S. Mishra. 2010. An assessment of the nutritional profile of milk in different seasons and locations in Varanasi through modern laboraotry techniques. *Indian Journal of Preventive and Social Medicine*, **41**(3): 237-239.

Roy, B., R.K. Mehla and S.K. Sirohi. 2003. Influence of milk yield, parity, stage of lactation and body weight on urea and protein concentration in milk of Murrah buffaloes. *Asian Austral. J. Anim*., **16**(9): 1285-1290. DOI: 10.5713/ajas.2003.1285

Sahin, A., A. Yıldırım and Z. Ulutas. 2016. Changes in some physico-chemical content of Anatolian buffalo milk according to the some environmental factors. *Buffalo Bull*., **35**(4): 573-585. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/358414

Sharma, U.P., S.K. Rao and I.T. Zariwala. 1980. Composition of milk of different breeds of buffaloes. *Indian J. Dairy Sci*., **33**(1): 7-12.

Snedecor, G.W. and W.G. Cochran. 1994. *Staitical Methods*, 8th ed. IOWA State University Press, Ames, USA.

Sodi, S.S., M.L. Mehra, A.K. Jain and P.K. Trehan. 2008. Effect of non-genetic factors on the composition of milk of Murrah buffaloes. *Indian Vet. J*., **85**(9): 950-952.

Thakore, V. and N.K. Jain. 2018. Protein and fat examination from the raw milk of different mammalian species (cow, buffalo, goat, and human) with successive lactation days. *Pharma Innovation Journal*, **7**(10): 506-510. Available on: https://www.thepharmajournal.com/archives/2018/vol7issue10/PartI/7-10-57-423.pdf

Yadav, S.P., P. Sikka, D. Kumar, S. Sarkar, A.K. Pandey, P.S. Yadav and R.K. Sethi. 2013. Variation in milk constituents during different parity and seasons in Murrah buffaloes. *Indian J. Anim. Sci*., **83**(7): 747-751.

Yasmin, A., N. Huma, M.S. Butt, T. Zahoor and M. Yasin. 2012. Seasonal variation in milk vitamin contents available for processing in Punjab, Pakistan. *Journal of the Saudi Society of Agricultural Sciences*, **11**(2): 99-105. DOI: 10.1016/j.jssas.2012.01.002

Zaman, G., R.N. Goswami and A. Aziz. 2007. Milk constituent of swamp buffalo of Assam. *Buffalo Bull*., **26**(1): 25-27. Available on: https://kukrdb.lib.ku.ac.th/journal/

BuffaloBulletin/search_detail/result/286143

Zhou, L., Q. Tang, M.W. Iqbal, Z. Xia, F. Huang, L. Li, M. Liang, B. Lin, G. Qin and C. Zou. 2018. A comparison of milk protein, fat, lactose, total solids and amino acid profiles of three different buffalo breeds in Guangxi, China. *Ital. J. Anim. Sci.*, **17**(4): 1-6. DOI: 10.1080/1828051X.2018.1443288