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Effect Of Azolla As Extra Supplement On Milk Yield In Indigenous And Cross Breed Cows Of Ganjam District

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Abstract
The study was carried out in Berhampur city of Ganjam district, Odisha. Forty lactating cows were selected, twenty cows each from both indigenous and cross breed, between 3rd and 5th lactation period. Indigenous and cross breed cows were divided into two groups (10 cows each). Treated group of both the breed of cows were fed with 2 kg fresh azolla, 4 kg concentrated feed, 3 kg chopped paddy straw and 50 gm mineral mixture in equally divided doses twice daily. Control group of both the breed of cows were fed with 6 kg of concentrated feed, 3 kg chopped paddy straw and 50 gm mineral mixture in equally divided doses twice daily without azolla. The feeding trail was tested for 3 months (25th June 2017 to 29th September 2017). During the trial period milk yield were recorded every day. After three months, the milk samples were collected for 7 consecutive days. Statistical analysis of data showed that, azolla increases the milk yield capacity in treated group of indigenous and cross breed cows ($P<0.001$) significantly when compared with their control group. The milk yield was increased up to 24.75% and 17.38 % in indigenous and cross breed cows respectively. This study reveals that consumption of azolla increases the milk production and maintained good vigour in dairy cattle.

INTRODUCTION

Livestock plays an important role to provide nutritional and employment security for the rural households in the country. Dairy animal's productivity is mainly depends on appropriate management of feeding. Balanced and proper feeding results optimum milk production (Roy *et al.,* 2018). Forage - based economical feeding strategies are necessary to reduce the production cost of quality livestock products (Singh *et al.,* 2017). Azolla is a potential feed supplement for livestock which contains rich mineral profile and nutrient (Satish and Ustuge, 2009). Azolla is a floating fern which can grow very quickly on the surface of the water. It floats on the water surface through numerous, closely, small, overlying scale such as leaves along with the roots which usually lynching under water. It is the top most aquatic nutritive plants owing to its high amount of protein and carotenoids content. Azolla is used as a bio fertilizer. It can be used as a partial substitute for synthetics nitrogen fertilizer because of its continuous supplementation of nitrogen to the rice crops and related development of soil fertility (Yao *et al.,* 2018). Azolla is also known as "Green Gold Mine". It is usually used as a bio fertilizer and green manure in the rice crops. For ruminants and non-ruminant's type of livestock, azolla can be used as a feeding ingredient either in fresh or dried form. Azolla is also used as a water purifier, medicine and production of human food and bio gas (Giridhar *et al.,* 2013; Roy *et al.,* 2016).According to Roy *et al.,* (2016) substitute of concentrated feed by A*zolla pinnata* at 5% level enhanced the growth rate and feed conversion efficiency of haryana heifers. Adaptation of azolla in India has been sporadic and slow, because of poor yield storage, difficulties of pest handling and labour (Tamizhkumaran & Rao, 2012). Azolla can grow in a natural way in the inactive water of canals, drains, marshy lands, rivers and ponds. It is full of rich protein, necessary amino acids, vitamins, growth promoters and minerals. It contains 20.0 to 25.5% protein, 3.1 % fat, 34.9% carbohydrates but oil contents are very low (Basak *et al.,*2002). Azolla may serve as a valuable protein supplemented feed for sheep, goat, pig, rabbits & poultry. In the present scenario the dairy farmers are reliant on marketable feeds which are not economical for livestock production. The utilization of azolla as a feed supplement for the cow was recently grown among many farmers. Very few inputs and management are required for azolla. It is one of the best nutrientive supplements for its high content of crude protein (Giridhar *et al.,* 2012). Azolla is considered as an efficient and economic substitutes feed supplement for the cattle as it can be easily digestible by the dairy animals due to the low lignin and high protein content. Azolla contains about 20% - 25% CP on a dry weight. Azolla has also

some important minerals like phosphorus, magnesium, copper, iron, manganese, calcium along with appropriate quantities of vitamin B_{12} and vitamin A. It has also many required amino acids, probiotic, beta carotene and bio-polymers (Singh *et al.,* 2017). Chemical analysis of sun dried and ground azolla contains 24.1 % crude protein, 3.75% ether extract, 15.1% crude fiber, 40.25 % nitrogen free extract, 16.8% ash, 2.18 % calcium and 0.47 % phosphorus on dry matter basis (Nidhi *et al.,* 2015).

OBJECTIVES OF THE STUDY:-

The purpose of the current study was to know the effect of azolla as extra supplement on milk yield in indigenous and cross breed cows of Ganjam district.

MATERIALS & METHODS:-

The study was carried out in Berhampur city of Ganjam district, Odisha. Forty lactating cows were selected, twenty cows from both indigenous (Ghumsari breed) and cross breed (Jersey cross), between 3rd and 5th lactation period. Indigenous and cross breed cows were divided into two groups (10 cows each). Treated group of both the breed of cows were fed with 2 kg fresh azolla, 4 kg concentrated feed, 3 kg chopped paddy straw and 50 gm mineral mixture in equally divided doses twice daily. Control group of both the breed of cows were fed with 6 kg of concentrated feed, 3 kg chopped paddy straw and 50 gm mineral mixture in equally divided doses twice daily without azolla. The feeding trail was tested for 3 months (July 2017 to September 2017). During the trial period milk yield were recorded every day (Figure 1-4). After three months, the milk samples were collected for 7 consecutive days and measured by measuring cylinder (Table 1-4). The data was analyzed statistically by using student's t-test.

Azolla culture in veterinary office, Berhampur

Azolla collection at veterinary office, Berhampur

Artificial pond used for cultivation of Azolla

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Collection of azolla at Alakash dairy farm

***Azolla pinnata* at Alakash dairy farm**

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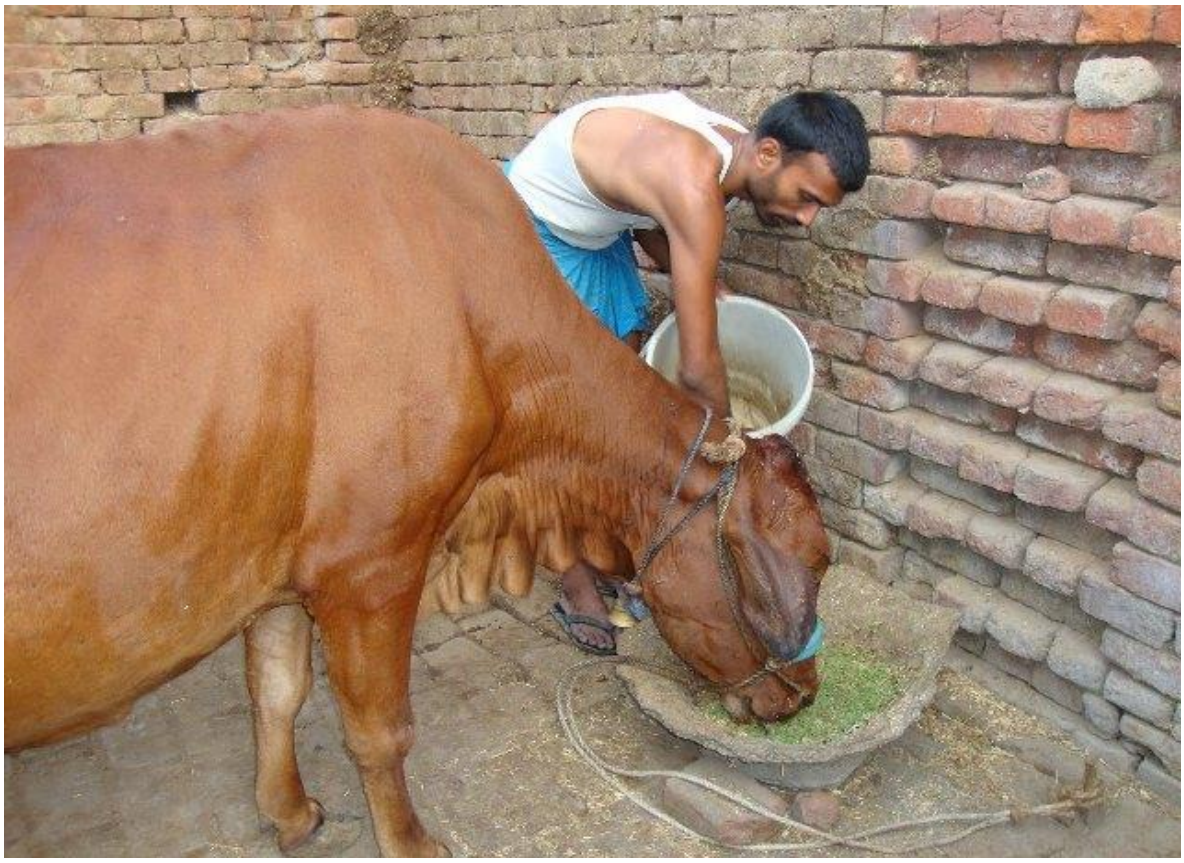

Azolla feeding to the cow

RESULT

Figure -1: Effect of nutritional supplement (Azolla) on milk yield of Indigenous breed cows for 90 days. Value of milk is litre/day.

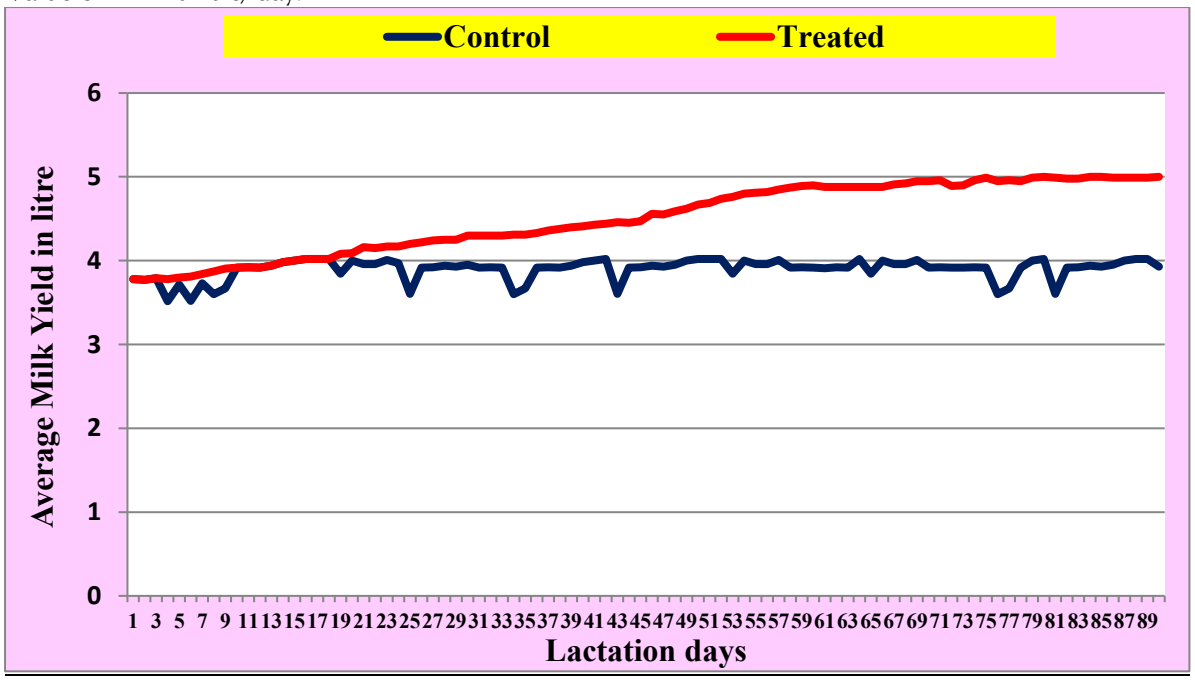

Figure -2: Effect of nutritional supplement (Azolla) on milk yield of Cross breed dairy cows for 90 days. Value of milk is litre/day.

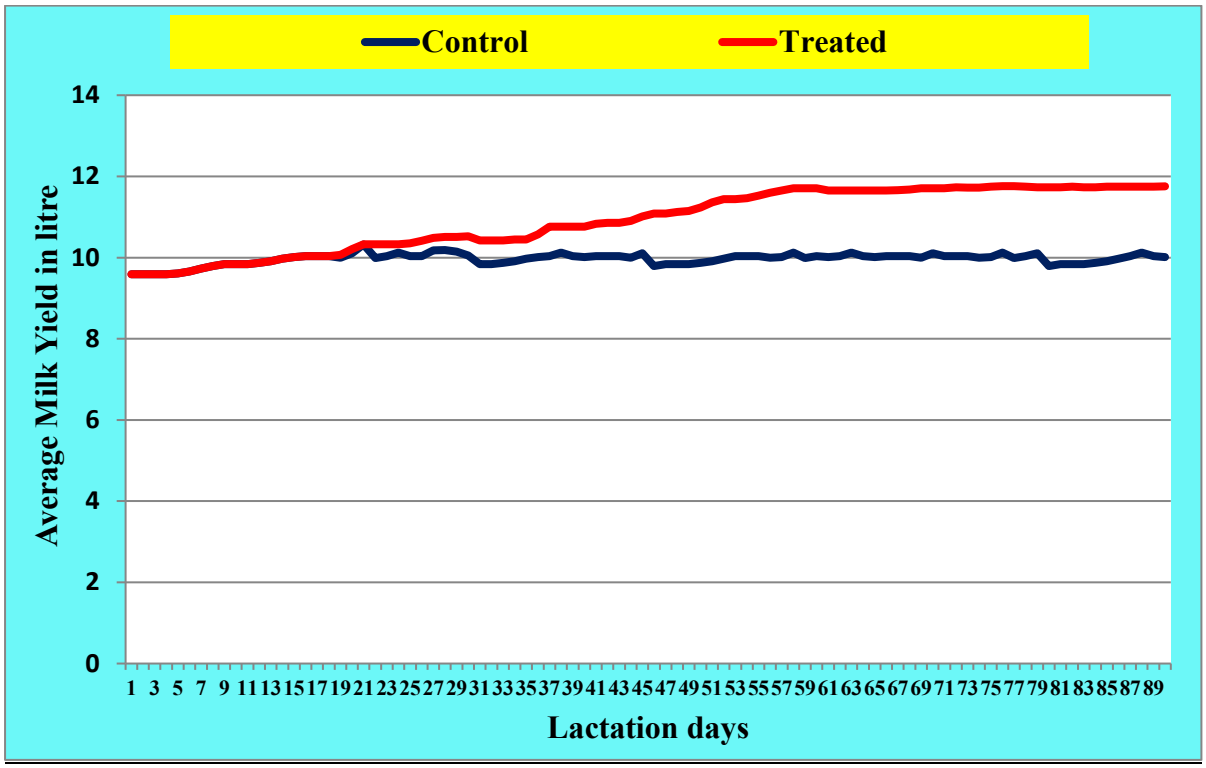

Figure -3: Milk yield of control group of Indigenous breed and Cross breed dairy cows for 90 days. Value of milk is litre/day.

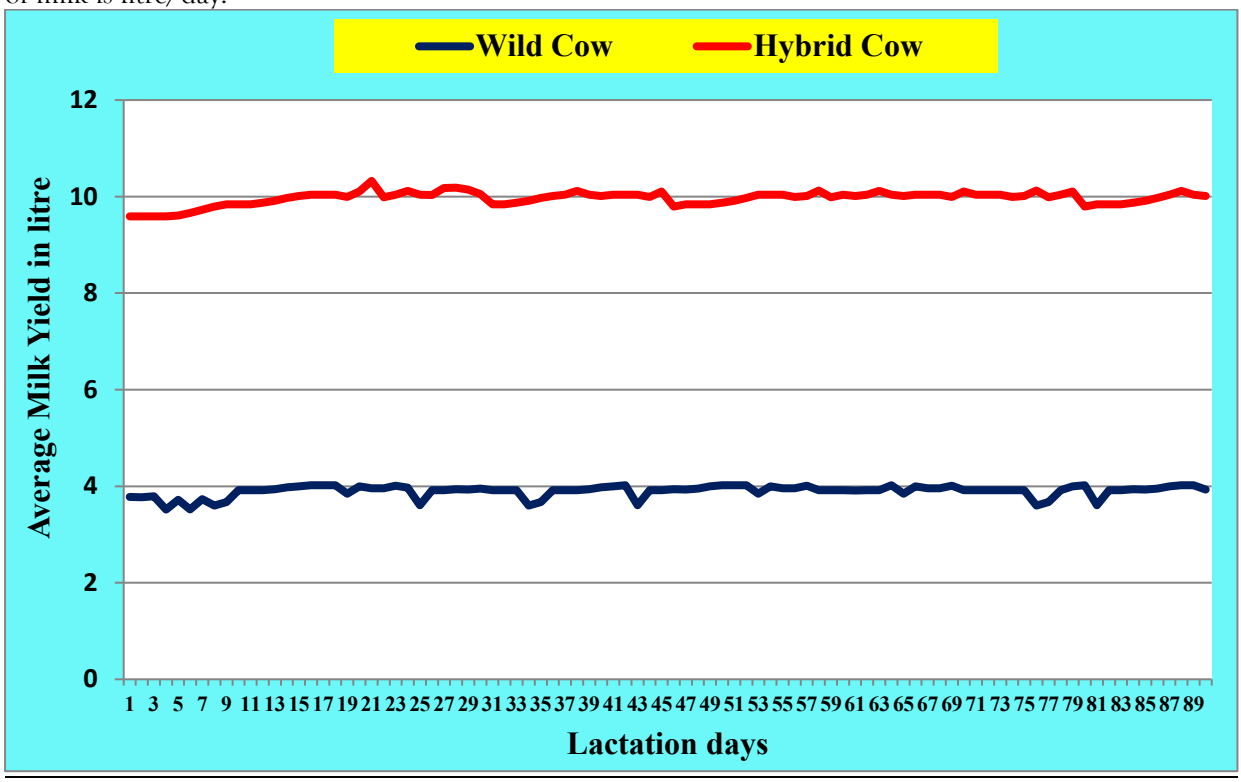

Figure -4: Effect of nutritional supplement (Azolla) on milk yield of treated group of Indigenous and Cross breed dairy cows for 90 days. Value of milk is litre/day.

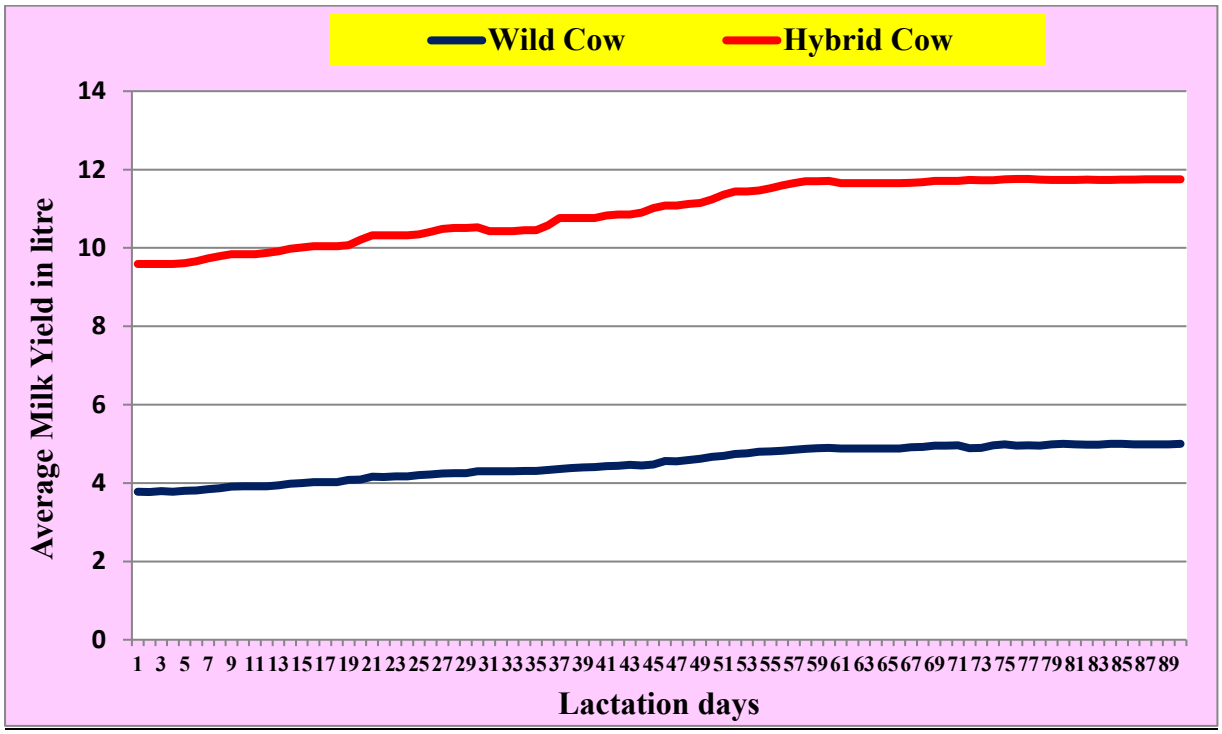

Table -1: Milk yield of Indigenous breed cow (control) from day 1 to day 7 (after trail period of 90 days)

Sl. No.	No. of Cow (Control)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	Cow No. 1	3.9	3.8	4	4.1	4.2	4.1	4.1
2	Cow No. 2	4	4	4.2	4.4	4.4	4.2	4.5
3	Cow No. 3	3.5	3.8	3.9	3.7	3.7	3.7	3.9
4	Cow No. 4	3.9	3.9	4.1	4.1	4.2	4.1	4
5	Cow No. 5	3.9	3.8	3.9	4	4	4.1	3.9
6	Cow No. 6	3.7	3.8	3.7	3.9	4	4.1	4
7	Cow No. 7	3.9	3.8	3.9	4.1	4	4.1	4.1
8	Cow No. 8	4	4.2	4.2	4.1	4.2	4.2	4.1
9	Cow No. 9	3.9	3.9	3.7	3.9	4.1	4.2	4.2
10	Cow No. 10	3.9	3.9	3.9	3.9	4	4.2	4.2
	Sum	38.6	38.9	39.5	40.2	40.8	41	41
	Average	3.86	3.89	3.95	4.02	4.08	4.1	4.1
	SD	0.151	0.129	0.178	0.187	0.187	0.149	0.176
	SEM	0.048	0.041	0.056	0.059	0.059	0.047	0.056

Table-2: Milk yield of Indigenous breed cow (treated) after nutritional supplement (Azolla) from day 1 to day 7 (after trail period of 90 days).

Sl. No.	No. of Cow (Treated)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	Cow No. 1	5.2	5.1	5.2	5.1	4.9	5.1	5

2	Cow No. 2	4.8	4.7	4.8	4.9	5	5	5.1
3	Cow No. 3	4.9	4.8	4.7	5.1	5.2	5	5
4	Cow No. 4	4.9	4.8	4.8	5.1	5.1	5	5.1
5	Cow No. 5	5.1	5.2	5	4.9	5	5.1	5.1
6	Cow No. 6	4.9	4.8	4.7	4.8	5	5.1	5.1
7	Cow No. 7	4.7	4.8	4.7	4.9	4.7	5.1	5.1
8	Cow No. 8	4.9	4.8	4.9	5	5.1	5.2	5.1
9	Cow No. 9	5	5	5.1	5.2	5.2	5.1	5.1
10	Cow No. 10	4.9	5.1	4.9	5.1	5.2	5.2	5.1
	Sum	49.3	49.1	48.8	50.1	50.4	50.9	50.8
	Average	4.93	4.91	4.88	5.01	5.04	5.09	5.08
	SD	0.142	0.173	0.175	0.129	0.158	0.074	0.042
	SEM	0.045	0.055	0.055	0.041	0.05	0.023	0.013

Table-3: Milk yield of cross breed cow (control) from day 1 to day 7 (after trail period of 90 days)

Sl. No.	No. of Cow (Control)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	Cow No. 1	10.5	10.8	10.7	10.2	10.5	10.1	10
2	Cow No. 2	10.5	10.2	9.5	9.5	10.5	10	10.2
3	Cow No. 3	9	9	9.5	10	10	10.2	10.5
4	Cow No. 4	10	10	10.5	10.8	10.5	9.5	9
5	Cow No. 5	9	9	9.5	10.5	10.3	10.5	10
6	Cow No. 6	9.9	10	9.8	10.1	10.2	10.3	10.1
7	Cow No. 7	10.1	10	10	10.1	10	10	10.1
8	Cow No. 8	9.8	9.7	9.6	9.7	9.8	9.8	9.7
9	Cow No. 9	10	10.1	10	10.3	10.3	10.1	10.5
10	Cow No. 10	9.8	9.7	9.8	10.3	10.2	10.3	10.2
	Sum	98.6	98.5	98.9	101.5	102.3	100.8	100.3
	Average	9.86	9.85	9.89	10.15	10.23	10.08	10.03
	SD	0.517	0.542	0.423	0.372	0.241	0.282	0.432
	SEM	0.163	0.171	0.134	0.118	0.076	0.089	0.137

Table-4: Milk yield of cross breed cow (treated) after nutritional supplement (Azolla) from day 1 to day 7 (after trail period of 90 days).

Sl. No.	No. of Cow (Treated)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	Cow No. 1	11.9	11.7	11.8	11.9	11.7	11.9	11.9
2	Cow No. 2	11	11.2	11.5	11.4	11.5	11.3	11.7
3	Cow No. 3	11.8	11.7	11.4	11.8	12	12.2	12.1
4	Cow No. 4	12	11.7	11.8	11.9	12.2	12.1	12
5	Cow No. 5	11.4	11.8	11.9	11.8	11.8	11.7	11.9

6	Cow No. 6	11.5	11.8	11.5	11.9	12	12	12.1
7	Cow No. 7	11.8	11.7	11.9	11.8	11.7	12	12.2
8	Cow No. 8	11.7	11.5	11.5	12.2	12	12	12
9	Cow No. 9	11.5	11.5	11.2	11.5	11.5	11.6	11.7
10	Cow No. 10	11.4	11.5	11.4	11.5	12	12	12
	Sum	116	116.1	115.9	117.7	118.4	118.8	119.6
	Average	11.6	11.61	11.59	11.77	11.84	11.88	11.96
	SD	0.298	0.185	0.242	0.241	0.237	0.27	0.165
	SEM	0.094	0.059	0.077	0.076	0.075	0.085	0.052

Table- 5: Effect of nutritional supplement (Azolla) on milk yield of Indigenous breed cow (Day 1 to day 7). Average milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
	Milk Yield	**Milk Yield**	**Milk Yield**	**Milk Yield**	**Milk Yield**	**Milk Yield**	**Milk Yield**
Control	**3.86 ± 0.04**	**3.89 ± 0.04**	**3.95 ± 0.05**	**4.02 ± 0.05**	**4.08 ± 0.05**	**4.1 ± 0.04**	**4.1 ± 0.05**
	(10)	**(10)**	**(10)**	**(10)**	**(10)**	**(10)**	**(10)**
P	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**	**P < 0.001**
Treated	**4.93 ± 0.04**	**4.91 ± 0.05**	**4.88 ± 0.05**	**5.01 ± 0.04**	**5.04 ± 0.04**	**5.09 ± 0.02**	**5.08 ± 0.01**
	(10)	**(10)**	**(10)**	**(10)**	**(10)**	**(10)**	**(10)**

Figure -5: Effect of nutritional supplement (Azolla) on milk yield of Indigenous breed cows for 7 days. Value of milk is litre/day. Columns represent the mean values and vertical bars SEM.

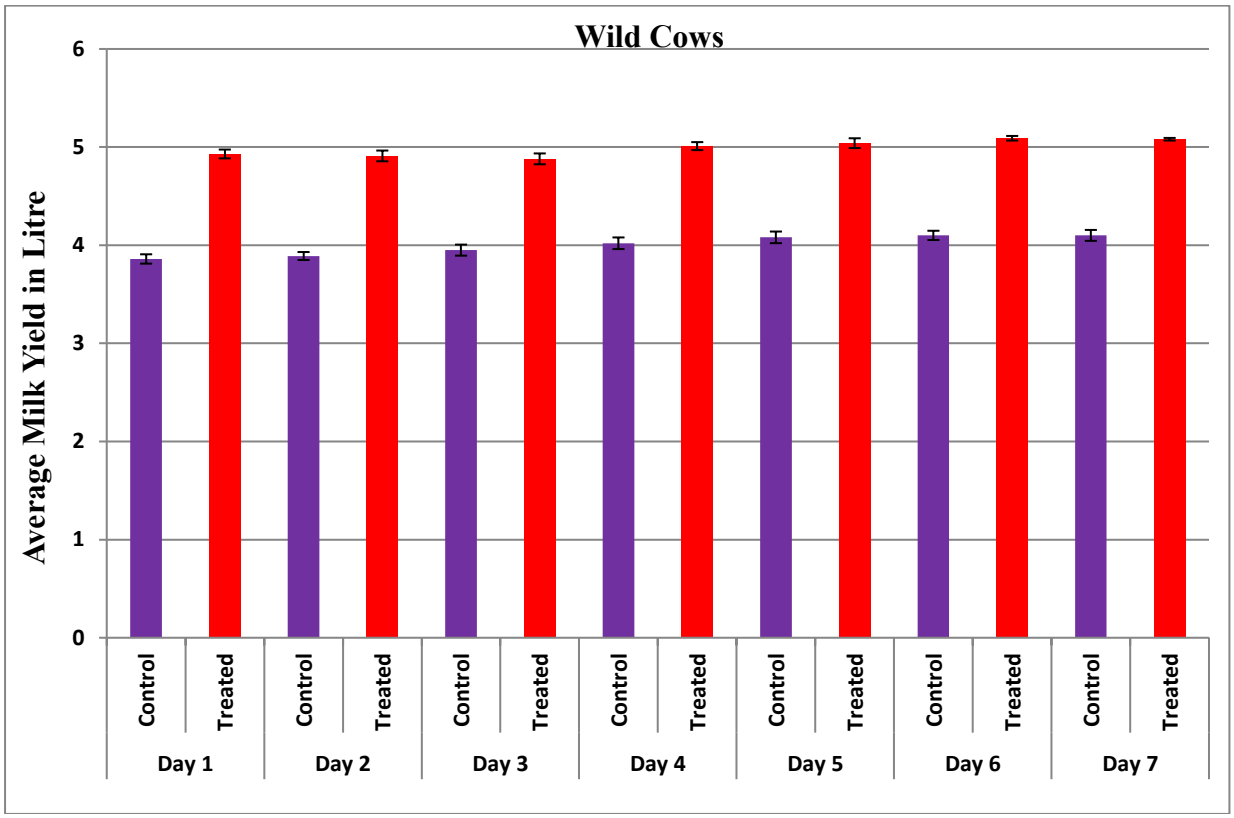

Table-6: Effect of nutritional supplement (Azolla) on milk yield of cross breed cow (Day 1 to day 7). Average milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield
Control	9.86 ± 0.16	9.85 ± 0.17	9.89 ± 0.13	10.15 ± 0.11	10.23 ± 0.07	10.08 ± 0.08	10.03 ± 0.13
	(10)	(10)	(10)	(10)	(10)	(10)	(10)
P	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001
Treated	11.6 ± 0.09	11.61 ± 0.05	11.59 ± 0.07	11.77 ± 0.07	11.84 ± 0.07	11.88 ± 0.08	11.96 ± 0.05
	(10)	(10)	(10)	(10)	(10)	(10)	(10)

Figure-6: Effect of nutritional supplement (Azolla) on milk yield of cross breed dairy cow's for7 days. Value of milk is litre/day. Columns represent the mean values and vertical Bars SEM.

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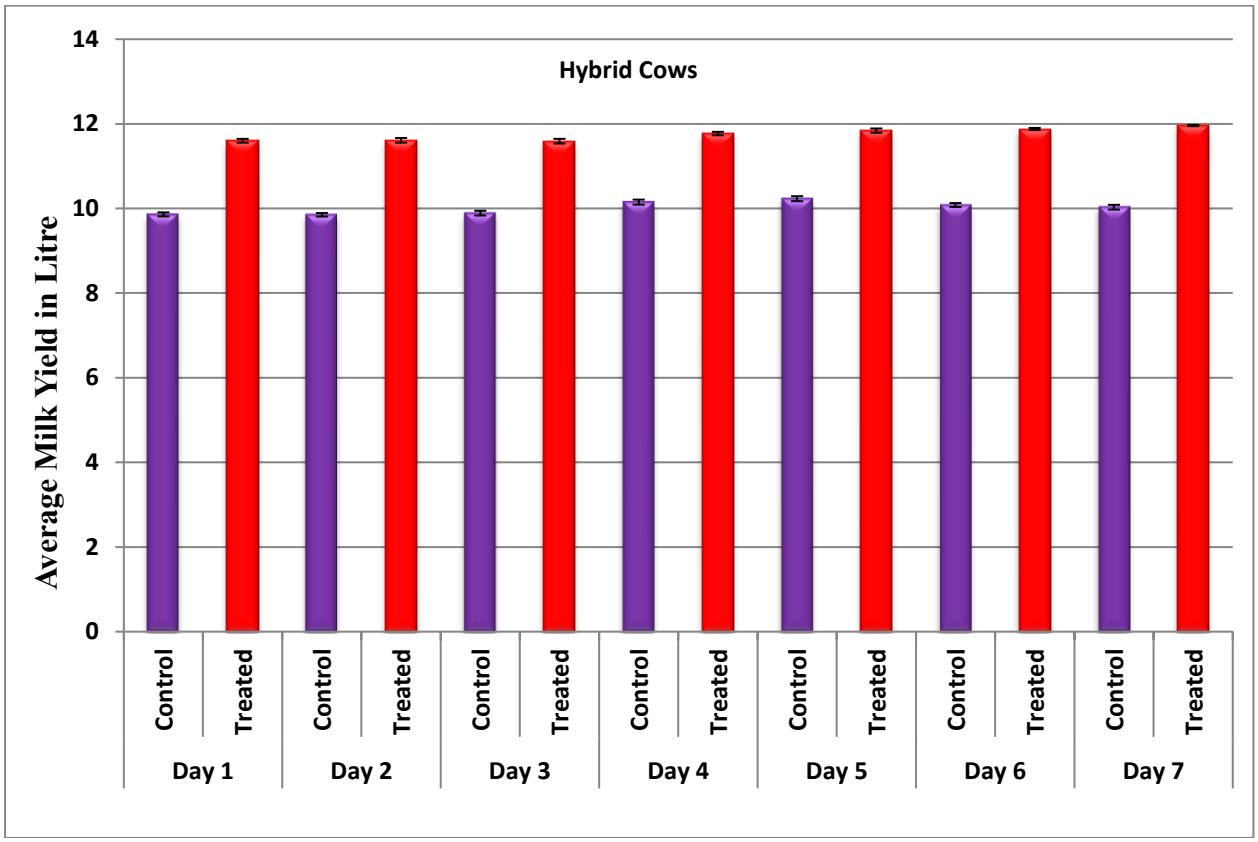


Table-7: Milk yield of control group in indigenous and cross breed cow (Day 1 to day 7). Average milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield
Indigenous Cow	3.86 ± 0.04	3.89 ± 0.04	3.95 ± 0.05	4.02 ± 0.05	4.08 ± 0.05	4.1 ± 0.04	4.1 ± 0.05
	(10)	(10)	(10)	(10)	(10)	(10)	(10)
P	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001
Cross breed Cow	9.86 ± 0.16	9.85 ± 0.17	9.89 ± 0.13	10.15 ± 0.11	10.23 ± 0.07	10.08 ± 0.08	10.03 ± 0.13
	(10)	(10)	(10)	(10)	(10)	(10)	(10)

Figure -7: Milk yield of control group of indigenous and cross breed cows. Value of milk is litre/day. Columns represent the mean values and vertical bars SEM.

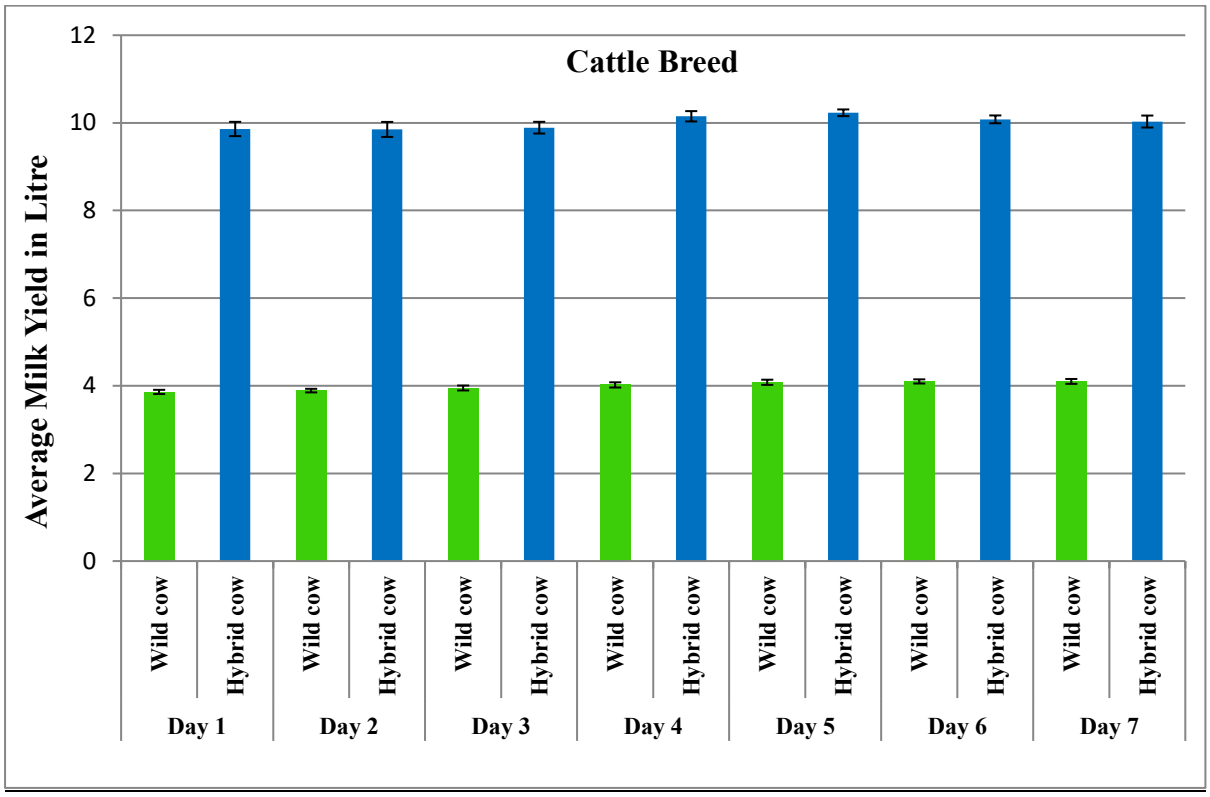


Table-8: Milk yield of treated group in indigenous and cross breed cow (Day 1 to day 7). Average milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield	Milk Yield
Indigenous Cow	4.93 ± 0.04	4.91 ± 0.05	4.88 ± 0.05	5.01 ± 0.04	5.04 ± 0.04	5.09 ± 0.02	5.08 ± 0.01
	(10)	(10)	(10)	(10)	(10)	(10)	(10)
P	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001	P < 0.001
Cross breed Cow	11.6 ± 0.09	11.61 ± 0.05	11.59 ± 0.07	11.77 ± 0.07	11.84 ± 0.07	11.88 ± 0.08	11.96 ± 0.05
	(10)	(10)	(10)	(10)	(10)	(10)	(10)

Figure -8: Effect of nutritional supplement (Azolla) on milk yield of treated group of indigenous and cross breed cows. Value of milk is litre/day. Columns represent the mean values and vertical bars SEM.

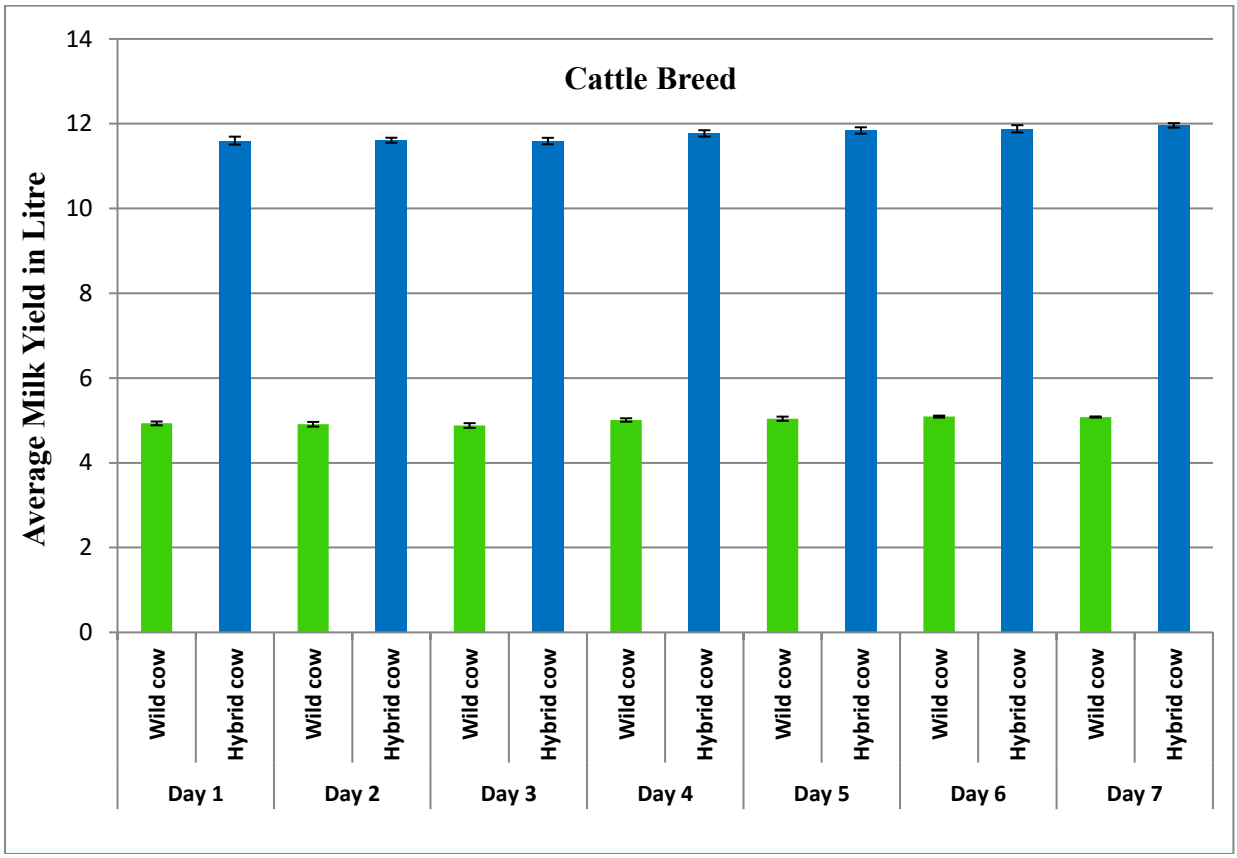


Table-9: Effect of nutritional supplement (Azolla) on average milk yield of indigenous and cross breed cows for 7 days. Milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	Indigenous	Cross breed
	Milk Yield	Milk Yield
Control	4.0 ± 0.11	10.01 ± 0.17
	(70)	(70)
P	P < 0.001	P < 0.001
Treated	4.99 ± 0.07	11.75 ± 0.15
	(70)	(70)

Figure -9: Effect of nutritional supplement (Azolla) on the average milk yield of indigenous and cross breed dairy cows for 7 days. Value of milk is litre/day. Columns represent the mean values and vertical bars SEM.

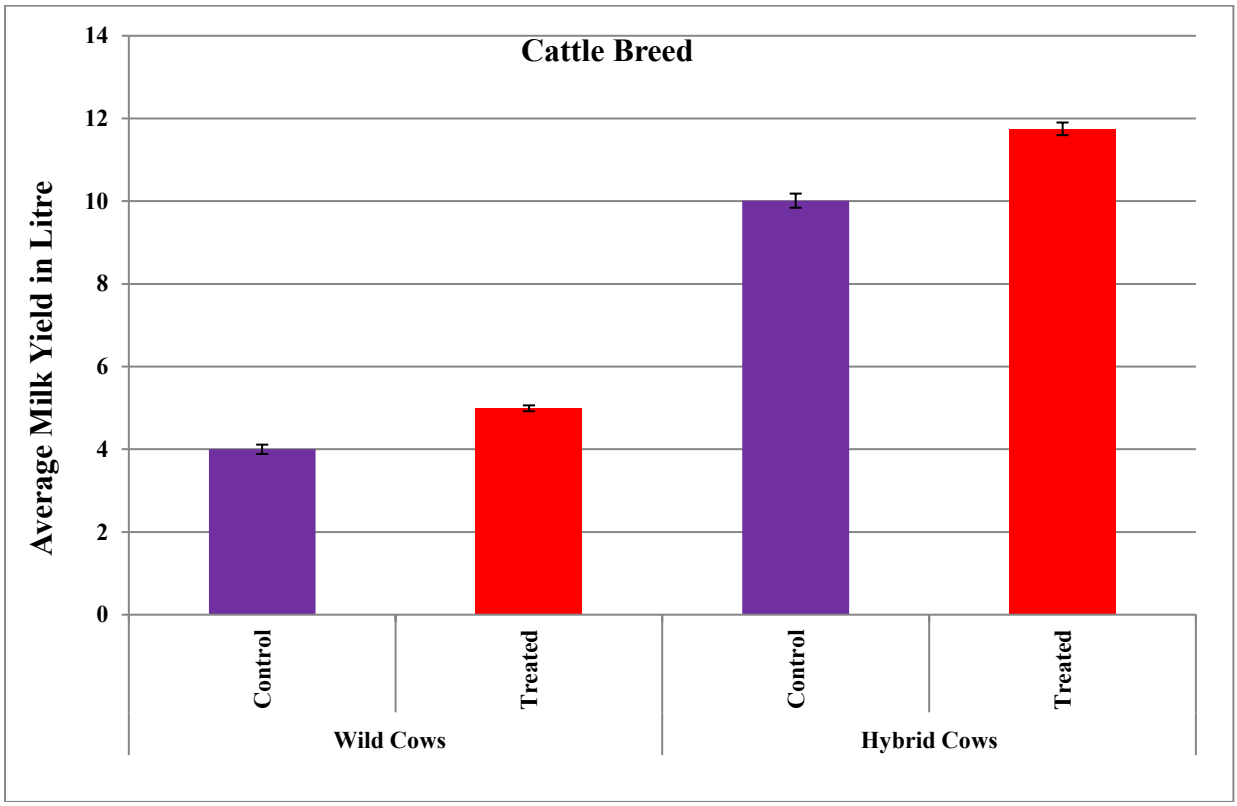


Table-10: Average milk yield of control groups, indigenous and cross breed cow for 7 days. Milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	Control Group
	Milk Yield
Indigenous	4.0 ± 0.11
	(70)
P	P < 0.001
Cross breed	10.01 ± 0.17
	(70)

Figure -10: Average milk yield of control groups, indigenous and cross breed dairy cow for 7 days. Value of milk is litre/day. Columns represent the mean values and vertical bars SEM.

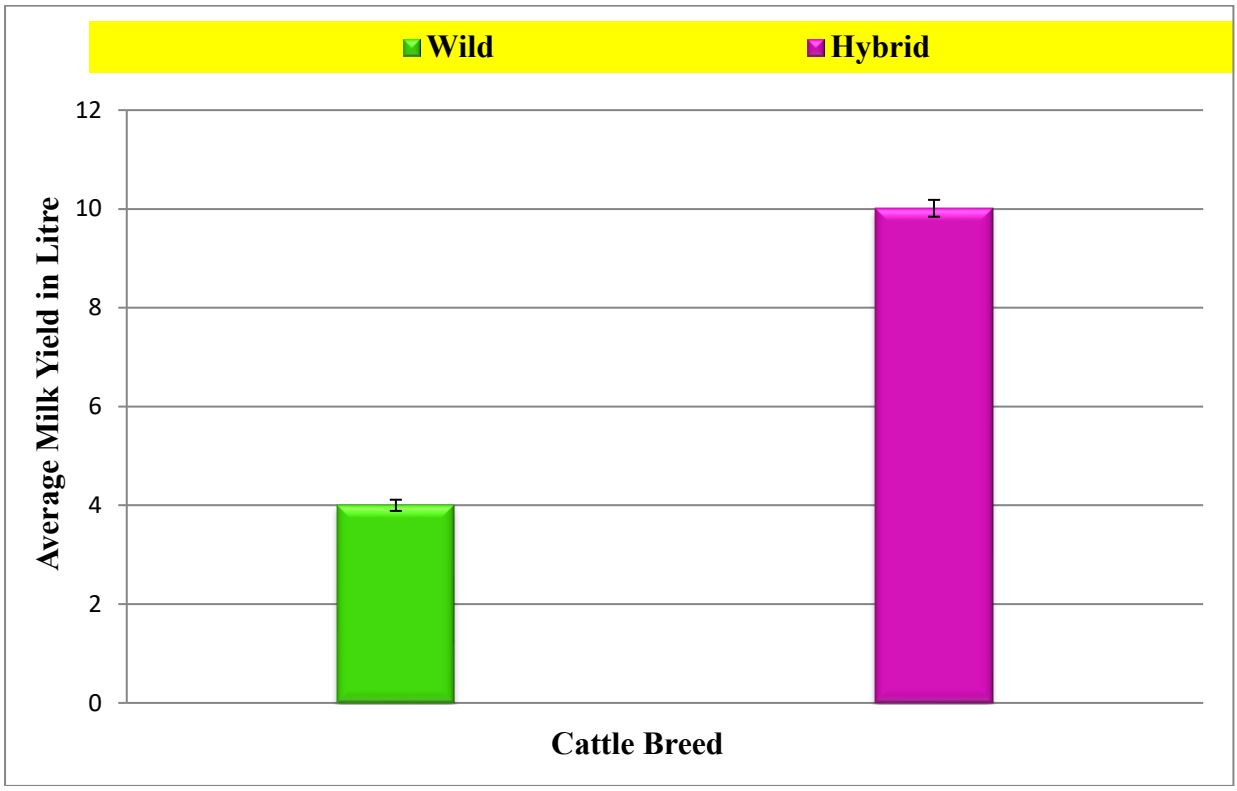
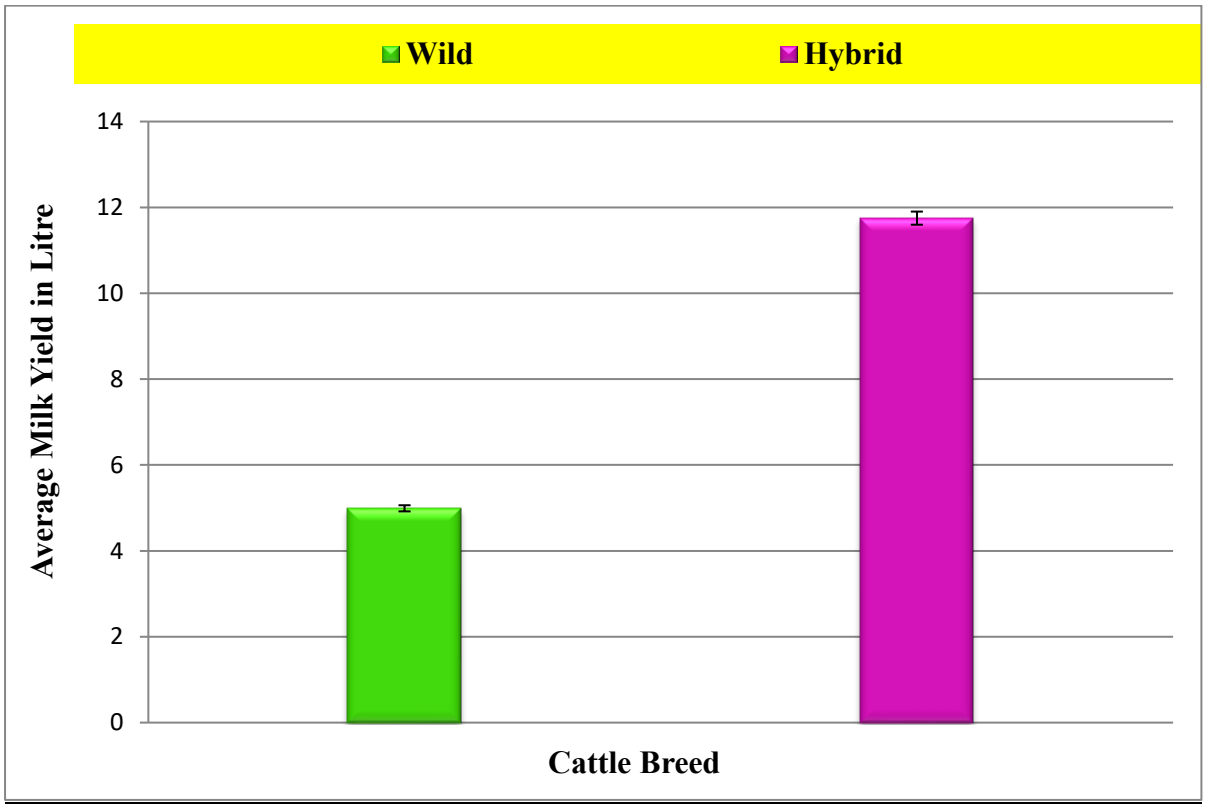


Table-11: Effect of nutritional supplement (Azolla) on average milk yield of treated groups, indigenous and cross breed cow for 7 days. Milk yield is litre/day. (Mean ± SEM), Numbers in parentheses indicate sample size.

Category	Treated Group
	Milk Yield
Indigenous	4.99 ± 0.07
	(70)
P	P < 0.001
Cross breed	11.75 ± 0.15
	(70)

Figure -11: Effect of nutritional supplement (Azolla) on milk yield of treated groups, indigenous and cross breed dairy cow for 7 days. Value of milk is litre/day. Columns represent the mean values and vertical bars SEM.



DISCUSSION

During the trial period milk yield were recorded every day. It was also observed that the milk yield was considerably high among the animals fed with azolla (treated group) both in indigenous and cross breed cows. Kumar and Chander (2017) found about 10-15 % increase in milk production in dairy animals after consumption of azolla. Azolla supplementation for 60 days enhanced the mean daily milk production from each cow by half a litre, and the higher milk yield was most probably due to supplementation of protein and essential amino acid through azolla (Giridhar *et al.*, 2013). According to Meena *et al.* (2017), the milk yield was increased from 8 litres per day to 9.30 litres per day after 60 days feeding of 1.5 kg azolla per day with conventional feed cotton seed cake in lactating buffalos. An average milk yield is increased by 1.30 litres per day, about 16.25 % increase in the milk yield is a tremendous improvement. It is in confirmation with Singh *et al.*, (2017), Mathur *et al.*, (2013) and Kamalasanana *et al.*, (2002) in buffalos. Kologi *et al.*, (2009) found 10% increase in milk yield in lactating buffalos. Many researchers have found many alternative feed & fodder to maintain the production of milk particularly during the offseason (Satish and Ustuge, 2009). Ambade *et al.*, (2010), Gouri *et al.*, (2012), Gowda *et al.*, (2015) and Rawat *et al.*, (2015) also found 10 percent increase in milk yield in cross breed cattle. But Murthy *et al.*, (2013) found a significant difference between the groups related to milk yield in crossbreed dairy cows. According to Murthy *et al.*, (2013), milking cows fed with 2 kg fresh azolla per day (replacing 50 percent of concentrate feed for three months) maintain good dairy performance while decreasing feed and labour cost, by 16.5 percent and milk production cost by 18.5 percent. Variations in the nutrient composition are possible due to the environmental conditions like nutrition, light intensity etc (Giridhar *et al.*, 2012). Azolla has positive effect on all stages of production and growth particularly to avoid some problems like low milk yield, short milking period, late maturity, milk fever, long dry period, repeat breeding, prolapsed of uterus in livestock. Azolla is most important for milk production and health of animals (Singh *et al.*, 2017). Azolla is a rich source of protein, minerals and other essential nutrients. It can be used for feeding of livestock (Gupta *et al.*, 2018). Azolla fed group showed a significant increase of 11.85% in milk production. After consumption of azolla, the cows were in good health conditions such as moist muzzle, better hair coat condition and brightness in eyes and remain active. Azolla can be used

as a valuable green supplement for dairy cows, under low input livestock production system, where livestock owners fed unbalanced concentrate feed. Azolla can fulfil the requirement of nutrients of dairy cows with concentrate feed (Roy *et al.,* 2018). By using azolla in an appropriate amount, one can get maximum production of milk with very good composition. Through this we can get more milk yield from Indigenous, Cross breed and exotic animals at low cost (Gupta *et al.,* 2016). In this study it was observed that, supplementation of azolla in the diet for 90 days, increases the milk yield gradually up to 8 weeks and remains constant thereafter. The maximum milk yield was 24.75% and 17.38 % per day in indigenous and cross breed cows respectively. Indigenous and cross breed cows of treated group showed higher milk yield in comparison to their respective control group. Dairy farmer is unable to fulfil the fodder requirements due to lack of natural grazing lands. In this situation azolla can be a better alternative option, as a protein rich fodder to livestock. Cultivation of azolla is very simple and requires low investment. Azolla is a nutritional supplement which helps to improved health condition of dairy cows. Cows are remaining healthy, active and it has no adverse side effect.

CONCLUSION

Azolla supplement increase the milk production along with good vigour in cow. Azolla is a very good nutritional supplement which enhances the milk yield of dairy cattle. The Small and marginal farmer can cultivate azolla within a short time with low cost budget. Azolla can be cultivated at anytime and anywhere with very less investment. Azolla is a cost effective partial replacement of concentrated feed for the dairy cattle. Feeding of azolla not only improves the milk yield and health condition of the dairy cows but also increase the income level of the dairy farmer. So it was inferred that azolla is an efficient nutritional supplement for dairy cows.

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