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Comparative Study on Effect of Hydroponic Fodders (Maize, Oat and Wheat) on Milk Yield and Milk Composition in Jersey Crossbred Cattle

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Abstract

This study looked at the effect of hydroponic maize, oat and wheat fodder on milk yield and milk quality in Jersey crossbred cows. The trial was done at the Dairy Unit, BAC Farm, Sabour, Bhagalpur. Eighteen healthy Jersey crossbred cows of similar age and milk yield were divided into four groups. One group was the control (n = 5) and got only the routine diet. Three groups got hydroponic fodder in addition to the routine diet: maize (T1, n = 5), oat (T2, n = 5) and wheat (T3, n = 5). Each cow in the treated groups got 10 kg fresh hydroponic fodder every day. The trial ran for 90 days. All cows were kept under the same conditions, and milk records were taken every day. The average daily milk yield was 5.2 L in the control group. It rose to 6.4 L in the maize group, 7.3 L in the oat group and 6.1 L in the wheat group. The oat group gave the highest milk yield. Milk fat was highest in the wheat group (4.60%). Oat gave the highest lactose (4.71%) and SNF (8.31%). The lowest somatic cell count (1.70 lakh cells/ml) was seen in the wheat group. Cows readily ate the hydroponic fodder and showed good feeding behaviour. The results show that hydroponic fodder, mainly hydroponic oat, can raise milk yield while keeping milk quality good in Jersey crossbred cows.

Keywords

Hydroponic fodder, maize, oat, wheat, dairy cattle, milk yield, milk composition, somatic cell count.

Introduction

Good feed is the base of high milk yield in dairy cows. Green fodder gives cows the nutrients, vitamins and minerals needed for milk production and good health. In India, green fodder supply is often short. Grazing land is shrinking, and there is more competition for agricultural land. This makes it hard for farmers to feed cows well through the year. Because of this, farmers need other ways to produce fodder for dairy cows.

Hydroponic fodder is a method of growing green feed without soil. Grains such as maize, wheat, barley and oat are grown in water under controlled conditions. Within 7 to 10 days, the seed grows into fresh green fodder made of shoots, roots and the leftover grain (Vastolo & Cutrignelli, 2025). This method uses much less water and land than normal fodder farming and gives a steady

supply of fresh feed all through the year (Ebenezer & Gnanaraj, 2026).

Nutrition management is one of the main factors that decides milk yield in dairy cows (Singh & Sharma, 2022; Dewangan *et al.,* 2026). Adding fresh, soft green fodder to the diet helps cows eat more feed and digest it better. Hydroponic fodder has high moisture and is easy to digest, so cows accept it well (Chavan & Kadam, 1989). When a seed sprouts, the hard starches and proteins in it break down into simpler forms that a cow can use more easily. This process also raises the level of vitamins and other useful compounds in the fodder (Dung *et al.,* 2010).

Past work shows that hydroponic maize fodder can raise milk yield. Naik et al. (2014) found that feeding hydroponic maize fodder raised crude protein digestion and increased milk yield in lactating cows. Hydroponic oat fodder has simple, fermentable carbohydrates and fibre that can help the rumen work better, and this may raise milk yield, lactose and SNF. Hydroponic wheat sprouts are rich in chlorophyll, vitamins and minerals, and some studies point to a rise in milk fat and a lower somatic cell count with wheat fodder, which is a sign of good udder health.

Still, direct comparisons of hydroponic maize, oat and wheat fodder, fed side by side under the same conditions, are limited, especially in Jersey crossbred cows kept under eastern Indian conditions. This study was therefore carried out to compare the effect of these three hydroponic fodders on milk yield, milk composition and somatic cell count in Jersey crossbred dairy cattle at BAC Farm, Sabour.

Materials and Methods

Location and animals

The study was carried out at the Dairy Unit, Bihar Agricultural College Farm, Sabour, Bhagalpur. Eighteen Jersey crossbred lactating cows of similar age and milk production level were selected for the trial.

Experimental design

The cows were placed into four groups under a Completely Randomized Design (CRD), as shown in Table 1.

Table 1: Control and treatment groups

Treatment	Fodder Type	Number of Cows
T_0	Control	5
T_1	Hydroponic Maize	5
T_2	Hydroponic Oat	5
T_3	Hydroponic Wheat	5

Feeding protocol

The feeding trial ran for 90 days. All cows received the routine farm ration of concentrate mixture and roughage. Cows in the T1, T2 and T3 groups received, in addition, 10 kg of fresh hydroponic fodder per cow per day. The control group (T0) received only the routine ration. All animals under trial were maintained under uniform feeding conditions throughout the study period. A common basal ration (Table 2) was provided to all animals to eliminate the possible variation due to differences in the diet. The basal ration was formulated using locally available feed ingredients and was offered uniformly to all experimental groups. The composition of the basal ration is presented in Table 2. Fodder was weighed accurately each day before feeding. Daily milk yield of each cow was recorded throughout the trial period. Milk composition and somatic cell count (SCC) was estimated using a Milkotester somatic cell counter. The instrument determines the number of somatic cells present in milk (lakh cells/ml), following the manufacturer's operating protocol, which is based on the direct microscopic reference principle for SCC estimation. All samples were analysed under standardized laboratory conditions

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Table 2: Composition of the basal ration fed to all experimental animals

Feed ingredient	Inclusion level (%)
Dry roughage	50.0
Maize meal	20.0
Wheat bran	15.0
Oil cake	12.5
Crushed jaggery	1.0
Mineral mixture	1.0
Common salt	0.5
Total	100.0

All experimental animals were offered 4 kg of the above concentrate mixture per animal per day, along with 6–7 kg of dry fodder and 10 kg of hydroponic green fodder (Maiz, Oat, and Wheat as T1, T2, and T3 respectively). In place of hydroponic fodder, an equivalent quantity of locally available seasonal green fodder was provided to the animals as under control in experimental design.

Observations recorded

- The Daily milk yield
- Milk fat (%)
- Protein (%)
- Lactose (%)
- Solids-not-fat, SNF (%)
- Somatic Cell Count, SCC (lakh cells/ml)
- Feed acceptance and feeding behaviour

Statistical analysis

The data were analysed using one-way analysis of variance (ANOVA) under a Completely Randomized Design (CRD). Where ANOVA showed a significant treatment effect, group means were compared using the Least Significant Difference (LSD) test at $P < 0.05$.

Results

Hydroponic fodder supplementation raised the average daily milk yield in all three treated groups compared with the control group (Table 3).

Table 3: Effect of hydroponic fodder on milk yield

Treatment	Milk Yield (L/day)
Control (T0; n=5)	5.2
Maize (T1; n=5)	6.4
Oat (T2; n=5)	7.3
Wheat (T3; n=5)	6.1

The oat group gave the highest milk yield, followed by the maize group and then the wheat group. All three treated groups produced more milk than the control group.

Effect on milk composition

Table 4 shows the effect of hydroponic fodder on milk fat, protein, lactose, SNF and somatic cell count.

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Table 4: Effect of hydroponic fodder on milk composition

Treatment	Fat (%)	Protein (%)	Lactose (%)	SNF (%)	SCC (lakh cells/ml)
Control	4.31	3.33	4.43	8.25	1.80
Maize	4.11	3.43	4.40	8.24	2.10
Oat	4.55	3.22	4.71	8.31	1.90
Wheat	4.60	3.16	4.32	8.12	1.70

The wheat group had the highest milk fat percentage. The oat group had the highest lactose and SNF values. The maize group had the highest protein percentage. The lowest somatic cell count was seen in the wheat group, and the highest was seen in the maize group.

Feeding behaviour

Cows in all three treated groups ate the hydroponic fodder readily and showed no feed refusal. They showed good feeding behaviour and settled quickly into the new feeding routine throughout the 90-day trial (Fig.1 and Fig.2).

Fig.1 Hydroponic fodder production unit at the Dairy Unit, BAC Farm, Sabour

Fig.2 Feeding behaviour of Jersey crossbred cows fed hydroponic fodder

Discussion

Milk yield

In this study, all three hydroponic fodders raised milk yield above the control, and hydroponic oat gave the best result. This agrees with past work on hydroponic maize, which found that feeding hydroponic maize fodder raised milk yield in Rathi and Gir cows (Naik et al., 2014, 2017; Limba et al., 2019; Sharma et al., 2019). It also fits the general idea that fresh, soft, digestible fodder helps a cow eat more feed and use it better (Chavan & Kadam, 1989; Dung et al., 2010).

The strong oat result needs a closer look. Most past work on oat and milk yield used oat silage, not fresh hydroponic oat sprouts. Oat silage has been shown to raise milk yield in some crossbred herds (Cardona-Iglesias et al., 2019), which agrees with the strong yield rise seen for oat in this study. But other work on oat-ryegrass silage found no real change in milk yield (Celis-Alvarez et al., 2016), and a trial with hydroponic oat sprouts fed to goats found no rise in milk yield (Marsico et al., 2009). These two findings do not fully support the result of the present study. The difference may be because goats digest feed in a different way from cattle, and Jersey crossbred cows may respond to oat sprouts differently from other breeds. Also, fresh hydroponic oat has more easily fermentable carbohydrate than silage, which may explain the stronger response seen here.

The wheat group in this study showed a smaller rise in milk yield than the oat and maize groups. This matches past work, which found that sprouted wheat did not change milk yield by a large amount when used to replace part of the concentrate (Zang et al., 2024). This suggests that hydroponic wheat may work more as a support feed for milk quality than as a strong booster of milk yield.

Milk fat

The wheat group had the highest milk fat in this study. This may be linked to better use of fibre in the rumen, which raises acetate, a building block used for milk fat synthesis. However, past studies give a mixed picture for wheat and milk fat. One study found that a 10% level of sprouted wheat did not change milk fat at all (Zang et al., 2024), and another found that wheat seedlings tended to lower milk fat (Wang et al., 2023). These results do not fully agree with the present finding. The difference may

come from the amount of wheat fed, the base diet used, or breed differences, since Jersey crossbred cows are known to carry naturally higher milk fat than some other breeds (Ormston et al., 2022).

The maize group had the lowest milk fat in this study. Past work shows that hydroponic maize can raise milk fat, but mainly at high feeding levels, such as when it replaces up to 75% of the crude protein in the concentrate (Limba et al., 2019; Sharma et al., 2019). At lower or fixed feeding levels, the rise in fat is small and not always significant (Naik et al., 2017). In the present study, maize was fed at a fixed amount of 10 kg per day and not at a high replacement level, and this may explain why milk fat did not rise in the maize group.

Milk protein, lactose and SNF

The maize group had the highest protein in this study. Past studies on hydroponic maize generally report that milk protein does not change much with feeding (Naik et al., 2014, 2017; Limba et al., 2019; Sharma et al., 2019). The small rise seen here may point to better microbial protein synthesis in the rumen under the feeding conditions of this trial, but this needs more study to confirm.

The oat group had the highest lactose and SNF in this study. Lactose is closely linked to propionate, another product of rumen fermentation. Since past work on oat silage found little change in lactose (Celis-Alvarez et al., 2016), the higher lactose seen here may come from the fresh, easily fermentable nature of hydroponic oat sprouts, which can support stronger rumen fermentation than fermented silage.

Somatic cell count

The wheat group had the lowest somatic cell count in this study, and the maize group had the highest. This agrees with past work showing that hydroponic wheat fodder can support better udder health and a lower somatic cell count. A lower somatic cell count is a sign of a healthier udder, so this result supports the idea that wheat fodder does not harm, and may even help, udder health in dairy cows.

Feeding behaviour

Cows in this study ate all three hydroponic fodders well, with no feed refusal. Past reviews note that feed texture and moisture affect how much a cow eats and how it chews its feed (Beauchemin, 2018), and hydroponic fodder, being soft and moist, is known to support good intake and feeding behaviour in ruminants (Cisneros-Saguilán et al., 2023; Vastolo & Cutrignelli, 2025). Some cattle studies report that hydroponic fodder does not always raise total dry matter intake, and may even lower it slightly while still improving feed use (Benu et al., 2024; Limba et al., 2019). Even so, the good acceptance seen in all treated cows in the present study points to a positive effect of hydroponic fodder on feeding behaviour in Jersey crossbred cattle.

General observations

Jersey crossbred cows are known to carry naturally higher fat, protein and better feed conversion than some other dairy breeds (Ormston et al., 2022). This means that part of the good results seen in this study may come from the breed itself and not only from the hydroponic fodder. Also, the control group in this study had fewer cows (n = 5) than each treated group (n = 5), so the results should be confirmed further with equal group sizes and cow-level statistical analysis before drawing firm conclusions.

Conclusion

Feeding Jersey crossbred cows 10 kg of fresh hydroponic fodder per day for 90 days raised milk yield above the control diet. Among the three fodders tested, hydroponic oat gave the highest milk yield. Hydroponic wheat gave the highest milk fat and the lowest somatic cell count. All three hydroponic fodders were well accepted by the cows. These results suggest that hydroponic fodder can serve as a useful extra green feed for dairy cows, mainly in areas where normal green fodder is hard to get. Further work with complete statistical analysis at the individual cow level is needed to confirm these findings.

Funding Statement

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Approval

Formal ethical approval was not required for this study.

Data Availability Statement

No new data generated in this study.

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