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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(10): 1459-1461

www.thepharmajournal.com
Received: 13-07-2023
Accepted: 20-09-2023

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Nutritive value of hydroponic and conventionally grown maize fodder in Assam: A comparative study

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Abstract
An study was conducted to evaluate the nutrient quality of hydroponically grown maize and conventionally grown maize. For the study, maize sprouts were produced in a low cost hydroponic unit in Instructional Livestock Farm (Cattle), Assam Agricultural University, Khanapara. Nutritive values of maize sprout were studied at 6th, 7th and 8th days and conventionally grown maize at 60 days. The dry matter content of maize seed decreased to its maximum level (22.89±0.14) at 8th of growth in hydroponic system which was significantly (p<0.05) lower than the conventionally grown maize fodder. The crude protein, ether extract and nitrogen free extract of hydroponic fodder are significantly (p<0.05) more than the conventionally grown maize fodder. Total Ash and crude fibre contents of hydroponic maize fodder were lower (p<0.05) than the fodder maize grown under conventional practices. It can be concluded that hydroponic maize fodders are more nutritious in terms of crude protein, ether extract and nitrogen free extract than conventionally grown maize fodders in Assam.

Keywords: Hydroponic maize, conventionally grown maize, nutritive value

Introduction
For sustainable dairy animal production, the supply of good quality green fodder round the year is very much essential. Green forages are rich and cheapest source of protein, carbohydrate, vitamins and minerals for dairy animals. But, currently the country faces a net deficit of around 28% green fodder, 10% dry fodder as per IGFRI Vision, 2050 [1]. It gets difficult to produce required quantity green fodder throughout the year due to shrinkage of land available for grazing, fodder cultivation, lack of water, more labour requirement and climatic changes. The unavailability of quality green fodder adversely affects the productive and reproductive performances of the dairy animals. The lack of green fodder compels the farmer to look for alternative options and explore sustainable methods of obtaining quality green fodder. Therefore, it is the need of the hour to improve the nutritional status of the dairy animals through modern scientific approaches. In such situation, the novel approach called Hydroponic fodder production would be one of the solutions.

Hydroponic Fodder Production is a technology of growing plants without soil, but in water or nutrient solution for a short duration in a controlled environment. Hydroponic fodder production systems require less space, and it is perfect for present situation with limited land for fodder cultivation specially in urban area. This system can be easily established indoors which can help in land preservation (L. Borah, 2023) [2]. Hydroponic systems are usually used to sprout cereal grains such as maize, barley, oats, wheat, sorghum or legumes such as alfalfa and cowpea. The hydroponics fodder is more palatable, digestible and nutritious while imparting other health benefits to the animals (Naik *et al*. 2015) [3]. Therefore, the present study was conducted to evaluate the nutritive value of hydroponically grown and conventionally grown maize in Assam.

Materials and Methods
Production of hydroponics maize fodder
Hydroponics fodder maize was produced in a low-cost hydroponic unit designed in an area of aprrox. 100 ft^2 with metal sheet as roofing material and shade net on all the sides to produce 200 kg/day hydroponic fodders at the Instructional Livestock Farm (Cattle), College of Veterinary Science, AAU, Khanapara, Ghy-22. The unit consists of four nos of GI rack with iron angles for holding160 plastic trays, each of dimension 1.5x 2 ft.

Good quality, clean seeds of maize (*Zea mays*) were transferred into a gunny bag after soaking in tap water for 12 hrs and were allow them to sprout.

Then sprouted seeds were transferred to trays from the gunny bags and placed the trays on the rack equipped with automatic sprayer irrigation of tap water. Inside the green house, the plants are allowed to grow for 8 days and then on 8th day, these are harvested and fed to the dairy animals.

Collection of samples, recording of data and analytical procedures

For analysis of nutrient content of Hydroponic fodder maize, samples were collected on 6th, 7th and 8th days and analyzed for proximate principles as per AOAC, 2016 [4]. Conventionally grown maize fodders were harvested and samples were analyzed for proximate principles on 60 days.

The experimental data were analyzed statistically by SPSS Statistics 20 following one way ANOVA. The means were compared by Duncan Multiple range test (DMRT) at 5% level of significance.

Results and Discussion

Nutrient Composition: The average DM content of maize seed was 93.94±0.14 whereas DM content of hydroponic fodder and conventional maize fodder were found 15.00±0.11 on 8th day and 22.89±0.14 respectively. The lower DM content in hydroponic fodders compared to conventionally grown fodder at 60 days may be due to large uptake of water initiates increasing metabolic activities of resting seeds leads to complete loss of dry weight (starch) during germinating cycles of hydroponic fodders (Morsy *et al.*, 2013) [5]. The decline in the starch content in the hydroponically grown fodder caused the depreciation of the dry matter (Zainab *et al.*, 2019) [6]. Seed soaking activates enzymes that convert starch stored in endosperm to a simple sugar, which produces energy and gives off carbon dioxide and water, leading to loss of DM with a shift from starch in the seed to fiber and pectin in the roots and green shoots (Bakshi *et al*, 2017) [7].

Table 1: Nutrient Composition of Hydroponic and conventionally grown maize fodder.

Nutrient Composition (%)	Maize seed	Hydroponic Maize			Conventional fodder on 60 days of harvesting
		Day 6	Day 7	Day 8	
DM	93.94 ^{A}±0.14	16.57 ^{B}±0.18	15.75^{C}±0.04	15.00 ^{D}±0.11	22.89 ^{E}±0.14
CP	9.10 ^{A}±0.28	12.46 ^{B}±0.17	13.64 ^{C}±0.10	14.64 ^{D}±0.07	9.34 ^{A}±0.29
EE	3.01 ^{A}±0.16	3.54 ^{B}±0.10	3.90 ^{B}±0.09	4.61 ^{C}±0.20	2.16 ^{D}±0.06
CF	2.59 ^{A}±0.08	8.43 ^{B}±0.27	9.53 ^{C}±0.02	11.46 ^{D}±0.19	25.24 ^{E}±0.26
NFE	83.97 ^{A}±0.49	73.58 ^{B}±0.64	70.15 ^{C}±0.91	65.60 ^{D}±0.59	54.41 ^{E}±0.81
Total Ash	1.34 ^{A}±0.02	1.99 ^{B}±0.11	2.78 ^{C}±0.24	3.69 ^{D}±0.15	8.84 ^{E}±0.29
NDF	39.64 ^{A}±0.31	40.81 ^{AB}±0.14	41.94 ^{B}±0.19	42.43^{B}±0.57	59.96^{C}±1.27
ADF	10.80 ^{A}±0.14	12.46 ^{A}±0.27	14.63 ^{C}±0.70	18.71 ^{D}±0.76	31.24^{E}±0.67

*****Mean values with different superscripts within row differs significantly.

The crude protein content of hydroponic fodders is significantly (p<0.05) more than seed and conventionally grown maize. Highest CP content was found on 8th days of growth. CP value is found higher in hydroponic fodder than that of conventionally grown fodder at 60 days and is in good agreement with that reported by Naik *et al*. (2012) [8]. The increase in protein content may be attributed to the loss in dry weight, particularly carbohydrates, through respiration during germination and thus longer sprouting time was responsible for the greater losses in dry weight and increasing trend in protein content (Chavan and Kadam, 1989) [9]. Sprouting alters the amino acid profile of maize seeds and increases the crude protein content of hydroponic fodder (Morsy *et al*., 2013) [5]. The CP content of conventional green fodder maize harvested at about 60days was similar to the earlier findings (Naik *et al.*, 2012 and Gupta *et al.*, 2004) [8, 10].

EE of hydroponic maize was found to be significantly (p<0.05) higher than seed and the conventionally grown maize. Highest EE content was found on 8th days of growth which might be due to the high chlorophyll content at that particular stage, which was extracted completely and determined as EE (Naik *et al.* 2012) [8]. The CF content of hydroponics fodder maize seed was 2.59±0.08 percent and increased (p<0.05) up to 11.46±0.19 percent on 8th of Growth. But CF of hydroponic maize fodder was lower (p<0.05) than the fodder maize grown under conventional practices (25.24±0.26 percent). The increase in CF content during sprouting of maize might be due to the synthesis of structural carbohydrates such as cellulose and hemicelluloses (Cuddeford, 1989; Chung *et al.*, 1989) [11, 12]. The NFE content of seeds decreased significantly up to 65.60±0.59 on 8th days of growth but the NFE values were significantly (p<0.05) more than the conventionally grown maize.The lower (p<0.05) CF content and higher (p<0.05) NFE content of the hydroponics green fodder than the conventional green fodder indicated the high leafy and succulent nature of the hydroponics green fodder which may be more palatable to livestock, particularly the dairy animals (Naik *et al.*, 2012) [8].

The TA content of the hydroponics fodder maize was increased with the advancement of the period, but all value were lower (p<0.05) than the TA content of the conventionally grown fodder maize (8.84±0.29). This result were in agreement to the reports of Naik *et al*., 2012; Naik *et al*., 2013 and Kide *et al*., 2015) [10, 13, 14].

Conclusion

From the above study it can be concluded that the hydroponic maize fodder is more nutritious in terms of Crude protein, Ether Extract and Nitrogen Free Extract than the conventionally grown maize fodder. Hydroponic technology can enable farmers to produce fodder for animals in a tap water within 8 days during fodder scarcity due shrinkage of land for cultivation or due to climatic impediments in Assam.

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