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Providing High Quality Forages with Hydroponic Fodder System

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Abstract. Hydroponic fodder is an alternative technology to provide the sustainability of high-quality forage for ruminant. Hydroponic sprout contains grass juice which is essential to increase the ruminant performance because the grass juice from hydroponic can contribute to the enhancement of microbial activity. The purpose of this study was to evaluate the effect of harvesting time toward fodder production and nutrient content of hydroponic maize fodder. This study used maize seed and hypochlorite solution for a disinfectant agent. The method used in this study was a completely randomized design (CRD) with 5 treatments. The treatments used was the difference of harvesting time, P1 = 8 days, P2 = 12 days, P3 = 16 days, P4 = 20 days, P5 = 24 days. Variables measured were % germination, growth (plant height), forage production, and nutrient content (dry matter, organic matter, crude protein, and crude fiber). The results showed that the harvesting time is a highly significant effect ($P < 0.01$) on plant height, forage production, and nutrient content. Based on research, hydroponic maize fodder has an advantage as a source of quality forage for livestock because it has a high protein. The crude protein contains on P1 with 12,36 %, P2 = 14,91%, P3 = 17,11%, P4 18,43% and P5 = 17,58 %. The conclusion is the 20th day of harvesting time has good quality and production as an alternative animal forage.

1. Introduction

Forage is the main feed for ruminants used in supporting ruminant productivity both in fulfilling the basic requirement, reproduction and production. Based on this reason, forage has a very important role for ruminants and its availability is needed continuously.

Currently, hydroponic systems or better known as hydroponic fodder can be used to produce quality plant as a source of forage for animal feed. Hydroponic fodder is an alternative technology used in producing forage for ruminants. Hydroponics is a term used in farming without using land as a medium for planting and using a mixture of essential nutrients dissolved in water [8]. At present the hydroponic system in the effort of providing animal feed forages is still being developed, this is because there are several approaches that influence the climate, costs and availability of infrastructure. According to [9] that there is no significant increase in increasing animal feed ingredients through planting grains and producing feed through hydroponic systems when compared to the initial dry ingredients of the seeds



used. The seeds usually contain 85-87% dry matter and hydroponic feed contains dry matter ranging from 80-85% but in some research results show that the advantages obtained from the hydroponic system are the increasing of crude protein value. Hydroponic fodder given to small and large ruminants have a good influence and without waste on the cost of producing feed crops. There are several advantages of fodder hydroponic, which only requires an area of 450 square to produce 1000 kg of feed every day, save water usage up to 95% because there is a recycling system in water use, grow throughout the year without climate affected, the harvesting period can be done in 8 days and save labor, energy and time [11]. The available of forage fodder with hydroponic systems as natural feed for an animal can provide several positive values, including increasing the percentage of fat in milk, rich in beta carotene and helping the synthesis of vitamin A and vitamin A have a large impact on reproduction [10].

The forages of animal feed used to fulfill the fiber needs of ruminants is corn. In Indonesia, maize or corn are generally planted in the lowlands both on marginal land or in the dry land. Corn plants need good aeration and drainage to support their growth and the availability of nutrients greatly affects growth and production. In addition to these factors, increased production of corn plants can be done by improving the level of plant density. Corn plants generally have a spacing of 70 cm x 30 cm or 75 cm x 25 cm with 2 seeds each plant hole, but if corn plants are taken as forage for fodder, the spacing is tighter, 50 cm x 20 cm with 2 seeds each holes with the hope that forage production will increase [6]. The advantage of hydroponic systems in corn is to shorten harvest time, which is approximately 14 days. There are several factors that influence the success of hydroponic systems, is environmental factors which include humidity, temperature and wind [8]. Nutrient content of hydroponic maize fodder has a higher value than maize seeds. In hybrid variety, the dry matter content is about 86.9%, crude protein 8.4% and crude fiber 2.04%. In local variety (inbreed line), the dry matter content is 79.8%, crude protein 9.3% and crude fiber 1.22% [1]. In other side, the hydroponic maize fodder content of nutrients has a higher value, crude protein 11-12% and crude fiber 2.4 - 3.8%. Therefore, hydroponic maize fodder has high potential as quality forage feed for ruminants. Based on this explanation, it is necessary to do research on the effect of harvesting time on the production of hydroponic maize fodder as forage for animal feed with the purpose to identify the best treatment in producing forage for animals.

2. Material and methods

The research will be carried out with the 2 (two) stages. The first is the manufacture of hydroponic maize fodder and the process of measuring of germination, production and height of plant for 8, 12, 16, 20 and 24 harvesting time. The second stage is the analysis of the nutritional content of hydroponic maize fodder, including the analysis of Dry Matter, Crude Protein and Crude Fiber conducted in the Laboratory. The location of the study was carried out in a greenhouse and proximate analysis was carried out at the Laboratory of Animal Nutrition and Feed, Faculty of Animal Science, Brawijaya University. The research material was corn seeds and the hypochlorite solution.

There are 5 treatments in this research. The treatments used based on the difference of harvesting time, P1 = 8 days, P2 = 12 days, P3 = 16 days, P4 = 20 days, P5 = 24 days. Variables measured were % germination, growth (plant height), forage production, and nutrient content (dry matter, organic matter, crude protein, and crude fiber).

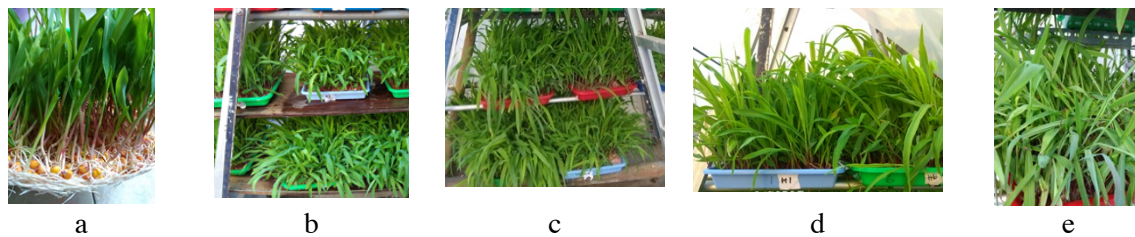
3. Result and discussions

3.1. Productivity of plants

Germination is a process of embryo growth and seed components and there is a role for the Giberlin hormone that promotes the formation and growth of roots and leaves. In the study, percent germination ranged from 47.2 to 50.4%. The results of the analysis show that there is no significant effect in treatments. The following are tables of germination of hydroponic maize fodder:

Table 1. Percentage of hydroponic maize fodder germination

No	Treatment	% Germination
1	8 days harvesting time	47.2
2	12 days harvesting time	50.4
3	16 days harvesting time	44.1
4	20 days harvesting time	48.4
5	24 days harvesting time	48.3

**Figure 1.** These figure describe the difference of harvesting time, (a) 8 days, (b) 12 days, (c) 16 days, (d) 20 days and (e) 24 days

Based on the research data, the results obtained showed that the treatment did not show significant differences. Calculation of germination in this study was carried out on the 3rd day.

In this research, forage production on the 8th day had reached twice the initial weight of the seed which reached 893.67 g, 1053.00 g on the 12th day, 1102.67 g on the 16th day, 1233.67 g the 20th day. Nevertheless, the 24th day showed a decrease of production amounted to 1170.33 g. The decreasing of production on the 24th day because the hydroponic maize fodder has wither characterized by leaves experiencing yellowing (withering).

The height of the hydroponic maize fodder on the 8th day and the 20th day the plant height reach 18.67 cm and 37.33 cm respectively. The 20th day harvesting time is the peak of the plant height, then the 24th day the plant begins to wither and does not grow significantly.

Table 2. Production of plants and the height of hydroponic maize fodder

No	Harvesting time	Production of hydroponic maize fodder (g)	Height of hydroponic maize fodder (cm)
1	8 days	893.67 ^a	18.67 ^a
2	12 days	1053.00 ^b	27.33 ^b
3	16 days	1102.67 ^b	37.17 ^b
4	20 days	1233.67 ^b	37.33 ^c
5	24 days	1170.33 ^b	37.07 ^c

Note: ^a Different superscript on the same column shows the significant effect (P <0.05)

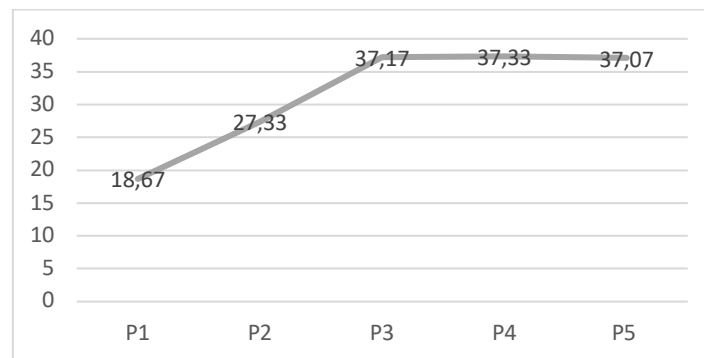


Figure 2. Height of hydroponic maize fodder (cm)

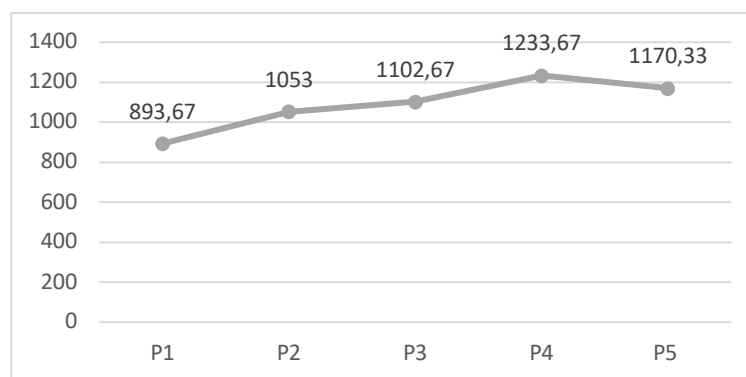


Figure 3. Production of hydroponic maize fodder (g)

Based on research shows that the forage production of hydroponic maize fodder is higher than sprout. The cultivation of hydroponic fodder is a production technology that stands out by offering advantages, as followed short cycle of harvesting time, continuous production out of season, less risk of climatic diversity, applied in any condition of seasons, require low water consumption, high productivity and high quality of nutrients [4,6].

3.2. Nutrition Content

Analysis of variance showed that the treatment had a significant effect on the nutritional content of hydroponic maize fodder. The following table contains the nutritional content of hydroponic maize fodder based on the harvesting time, are presented in Table 3.

Table 3. The nutritional content of corn hydroponics

No	Treatment	Ash	Crude Protein	Crude Fiber
		% Dry Matter		
1	8 days harvesting time	2.02 ^a	12.36 ^a	5.61 ^a
2	12 days harvesting time	2.37 ^b	14.91 ^b	7.44 ^b
3	16 days harvesting time	2,39 ^b	17.11 ^b	8.91 ^b
4	20 days harvesting time	2.60 ^b	18.43 ^c	10.90 ^c
5	24 days harvesting time	2.60 ^b	17.58 ^c	10.71 ^c

Note: Different superscript were significantly different (P<0.05)

Based on the table, it is known that there is an increase in the quality of nutrient content based on the harvesting time of hydroponic maize fodder. The nutrient content is increasing from harvest age 12 days

to 20 days. On the 20th day of harvesting time, protein content tends to be higher at 18.43%, but on the 24th day, the hydroponic maize fodder experienced a decrease in quality compared to the 20th day. This is characterized by the physical condition of the plant, which is the yellowish leaf, root moldy and withered. The increasing of CP increase as long as the harvesting time. Additionally, the sprouting has been reported to alter the amino acid profile of maize seeds and increases the crude protein content of hydroponic fodder [8]. Therefore, hydroponic maize fodder is nutritious and palatable with low cost techniques for production. Then, in several regions, hydroponic fodder become an effective alternative technology to provide the sustainability of livestock production because against impending climate change and less availability of land.

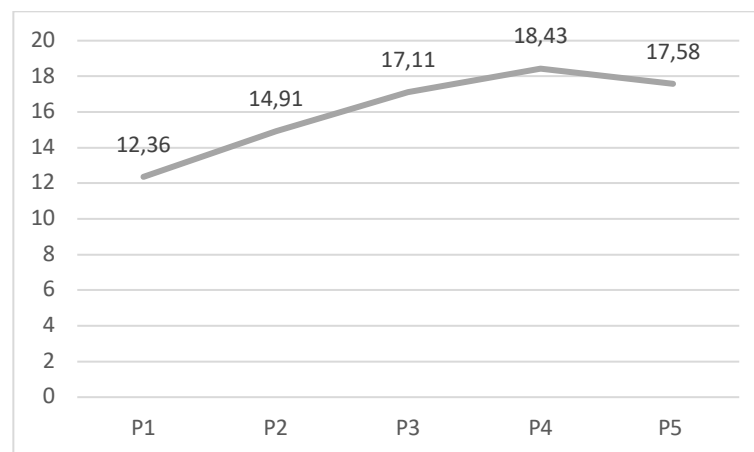


Figure 4. The Crude Protein of Hydroponic Maize Fodder

In this research, the crude fiber content was within a range of 5,61 – 10,71%. The increasing CF has a relation with the harvesting time. Additionally, the crude fiber content is the effect of the build-up of cellulose, hemicellulose, and lignin as a structural compound of cell wall of the plant [4]. The organic matter in this research is approximate 97,4 -97,98 %. During sprouting time, the total ash content increase based on the process of mineral absorption by the root, which will affect the number of organic matters [5]. The hydroponic sprouts contain a rich source of bioactive enzymes, chlorophyll and grass juice ingredients that increase the productivity of ruminant [10]. Sprouting of grains affected the enzyme activity, altering amino acid profile and improving the crude protein which is highly digestible by most ruminant. Hydroponic maize fodder become practical approach for increasing the fresh quality of forage.

4. Conclusions

Based on the research, it can be concluded that hydroponic maize fodder is one of alternative forage with good nutrition value because it has high crude protein content 18,34% (the 20th day of harvesting time).

References

- [1] Hana A A, Osfar S and Irfan H D 2013 Repostory UB
- [2] Anusavice K J 2004 *Buku Ajar Ilmu Bahan Kedokteran Gigi 10th edition* (Jakarta : EGC. Terjemahan dari: Philips' Science of dental materials)
- [3] AOAC 2005 14th ed. Association of Official Analytical Chemist: Washington
- [4] Araújo J S, Oliveira G F, Lima H C, Silva J S, Santos L, Souza M N, Rodrigues R C, Parente H N and Parente 2018 *Acad J Agric Res* **6**(2) 038-041
- [5] Dung D D, Godwin I R, Nolan J V 2010 *Journal of Animal and Veterinary Advances* **9** 2485-2492
- [6] Kusharono B and Iriani N 2003 *Prosiding Temu Teknis Fungsional Non Peneliti*
- [7] Morsy A T, Abul S F and Emam M S A 2013 *Research Journal of Agriculture and Biological*

Sciences **9** 341-350

- [8] Naik P K, Dhuri R B and Singh N P 2011 *Extension Folder No 45/2011* (Goa: ICAR Research Complex for Goa)
- [9] Naik P K 2012 *ICAR News* **18** 4
- [10] Naik P K *et al Indian Dairyman* 68-72
- [11] Rachel J E, Tensingh G, Muthuramalingam T and Devi T 2015 Tamil Nadu Veterinary and Animal Sciences University
- [12] Ramreke R, Doneria R, and Gendley M K 2019 *Acta Scientific Nuritional health* **3**