EVALUATION OF ALFALFA SPROUT (*MEDICAGO SATIVA*) GROWN IN A HYDROPONIC SYSTEM AND ITS IMPACT ON GROWTH PERFORMANCE IN NEW ZEALAND WHITE RABBIT

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CERTIFICATION

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Thank you

DEDICATIONS

In The Name of Allah, The Most Beneficent, The Most Merciful and The Most Gracious

This Thesis is dedicated to:

My Mother (Majmin binti Sabjan)

My Father (Jurit bin Osman)

My beloved family

My beloved nieces and nephews

My love

My cats

Friends

Classmate of 2017/2022

&

Faculty of Veterinary Medicine, Universiti Malaysia Kelantan.

Table of Contents

List of tables

List of appendices

ABSTRACT

An abstract of the research paper presented to the Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, in partial requirement on the course DVT 5436 - Research Project.

Alfalfa sprouts are sprouts usually consumed as a salad in the western country, which are mainly germinated and planted in the cold region. Alfalfa sprout is believed to have good nutrition and is high in proteins, minerals, and vitamins. This is a cross-sectional study to evaluate the suitable condition for the germination of alfalfa sprouts in Malaysia using a hydroponic system and the impact of feeding alfalfa sprouts to the New Zealand White rabbit on its growth performance. Thus, suitable conditions were determined during this research, and the growth performance of the rabbits was evaluated. The alfalfa sprout begin to germinate at temperature within minimum temperature of 28℃ and maximum temperature of 28.9℃ when it was germinated under hydroponic condition. The humidity observed for the germination of alfalfa sprout in this project was between 80% to 83%. Based on this project, the duration for the length of the alfalfa sprout to reach requirement height for it to be harvest which are minimum height of 7.5cm and maximum height of 8.0cm was 5 days. Both of the control and treatment groups shows increase in weight gain.

Keywords: *Alfalfa sprout, Temperature, Humidity, Growth performance*

ABSTRAK

Abstrak daripada kertas penyelidikan dikemukakan kepada Fakulti Perubatan Veterinar, Universiti Malaysia Kelantan untuk memenuhi sebahagian daripada keperluan kursus DVT 5436 - Projek Penyelidikan.

Pucuk alfalfa merupalan salah satu pucuk yang biasa digunakan sebagai salad di negara barat yang kebanyakannya bercambah dan ditanam di kawasan sejuk. Pucuk alfalfa mempunyai khasiat yang baik iaitu tinggi protein, mineral dan vitamin. Kajian ini merupakan kajian keratan rentas untuk menilai keadaan yang sesuai untuk percambahan pucuk alfalfa di Malaysia menggunakan sistem hidroponik dan kesan pemberian pucuk alfalfa sebagai makanan kepada arnab pedaging berbaka *New Zealand White* terhadap prestasi pertumbuhannya. Oleh itu, keadaan yang sesuai telah ditentukan semasa penyelidikan ini dan prestasi pertumbuhan arnab telah dinilai. Pucuk alfalfa mula bercambah pada suhu minimum 28 ℃ dan suhu maksimum 28.9 ℃, apabila ia bercambah dalam keadaan hidroponik. Kelembapan yang diperhatikan untuk percambahan pucuk alfalfa dalam projek ini adalah antara 80% hingga 83%. Berdasarkan projek ini, tempoh untuk pucuk alfalfa mencapai ketinggian keperluan untuk dituai iaitu ketinggian minimum 7.5cm dan ketinggian maksimum 8.0cm adalah selama 5 hari. Kedua-dua kumpulan menunjukkan peningkatan dalam penambahan berat badan.

Kata kunci: *Pucuk alfalfa, Suhu, Kelembapan, Prestasi pertumbuhan*

1.0 Introduction

Medicago sativa (Alfalfa) belongs to the pea family (Fabaceae) which it also considers as perennial flowering herbal plant. Alfalfa leaves are high in vitamins (e.g., vitamin A, B, C, D, E, and K) and minerals (e.g., phosphorus, calcium, iron and potassium). Humans can consume alfalfa in the form of sprouts, dehydrated leaves or dietary supplements such as tablets or powder. Alfalfa sprouts, for example, are typically consumed as a salad, and most of their sprouts are fluffy, crunchy, and sweet. Sprouts are the young seedlings produced by seed germination; they have been used as vegetables for thousands of years and have recently gained popularity in Western countries as a functional food. Protein, minerals, vitamins are all abundant in sprout (Almuhayawi *et a*l., 2021).

There is paucity of information regarding the planting of alfalfa sprout in Malaysia. However, alfalfa plant has been successfully planted in various part of Malaysia by using crop production system (Quaza *et al*., 2004). Therefore, there is need to grow alfalfa sprout using the hydroponic system because there is no published data about the process of germination of the alfalfa seed and growing it into the alfalfa sprout using the hydroponic system.

Hydroponic fodder production is a technique for germinating fodder seeds such as barley, cowpea, sorghum, wheat, and maize, into high-quality and disease-free animal feed in a hygienic environment which is free from chemicals such as insecticides, herbicides, fungicides, and artificial growth promoters (Jensen and Malter, 1995; Al-Hashmy, 2008). Hydroponically grown fodder has a short growing period of 7-10 days and requires only a minimal amount of space to produce (Mooney, 2005).

Rabbits are a fast-growing, prolific non-rodent animal with the ability to generate large amounts of meat in a short amount of time. It may be raised in a backyard barn and thrives on low-cost forages. As a result, rabbit farming is one of the viable ways for small-scale backyard businesses in developing nations to establish a profitable revenue source, as it not only receives demand for its meat, but also for its wool production and use as a domestic pet (Airina *et al*., 2021). Despite the benefits of rabbit farming, producers still face challenges such as a lack of fund and knowledge, as well as the high cost of feed and management (Ehsan, 2018). As a result, one of the efforts that should be made is to find alternate sources of feed, as this can reduce the cost of feed production for rabbit farmers.

Rabbits are most frequently used as laboratory models in animal research. New Zealand White is the common breed of rabbit that is being used for research purpose compared to other breeds such as Angora, Alaska and American Chinchilla. It is because this breed is less aggressive in nature and have less health problems as compared with other breeds (Mapara *et al*., 2012). The domestic rabbit belongs to the Lagomorpha taxonomic order. Although the rabbit shares some morphological characteristics with rodents, protein sequence evidence has led some to believe that rabbits are more closely related to primates than rodents. *Oryctolagus cuniculus* is the scientific name for rabbits. A buck refers to an adult male rabbit, a doe to an adult female rabbit, and a kit to an immature rabbit (Cunha and Cheeke, 2012).

Rabbit is a non-ruminant herbivore that fed on less fiber and high protein and carbohydrate portion of plant material. The tactile vibrissae on the upper lip, together with the cleft upper lip, enable the rabbit to locate and eat short grasses efficiently (Ringler and Newcomer, 2014 & Cunha and Cheeke, 2012).

2.0 Research problem

There was not enough supply of commercial feed to rabbit farmers during the Covid-19 pandemic because of movement control order (MCO) from one city to another. Furthermore,commercial feed or concentrate diets are expensive for farmers and thus resulting in a high cost of production. Therefore, to overcome the shortage in supply of commercial feed and reduced the cost, producing an alternative feed for rabbit which is alfalfa sprout may contributed in the rabbit industry.

3.0 Research questions

3.1 Does alfalfa seed germinate under a hydroponic system in Malaysia?

3.2 Does alfalfa sprout have high yield production when planted under a hydroponic system?

3.3 Does alfalfa sprout improve the growth performance of rabbits?

4.0 Research hypothesis

4.1 Alfalfa seed will germinate under a hydroponic system in Malaysia.

4.2 Alfalfa sprout have high yield production when planting under hydroponic system.

4.3 Alfalfa sprout can improve the growth performance of rabbits.

5.0 Research Objectives

5.1 To investigate the germination rate of alfalfa seed under a hydroponic system in Malaysia.

5.2 To observe the yield of alfalfa sprout production when planted using a hydroponic system.

5.3 To assess the growth performance of rabbits fed with alfalfa sprout grown under hydroponic conditions.

6.0 Literature review

6.1 Plant Distribution

Alfalfa (*Medicago sativa*) has a long and rich history. It is thought to be the oldest plant grown solely for forage. Alfalfa was cultivated before recorded history and can now be found growing wild from China to Spain and from Sweden to North Africa. An examination of the current distribution of cultivated alfalfa reveals that the crop is concentrated in specific zones within the northern hemisphere, namely the United States, Canada, Italy, France, China, and the southern USSR, as well as in selected countries in the southern hemisphere, namely Argentina, Chile, South Africa, Australia, and New Zealand (Michaud *et al*., 1988).

6.2 Alfalfa Sprout as Functional Food

Alfalfa leaves are high in vitamins (e.g., vitamin A, B, C, D, E, and K) and minerals (e.g., phosphorus, calcium, iron and potassium. Humans can consume alfalfa in the form of sprouts, dehydrated leaves or dietary supplements such as tablets or powder. Alfalfa sprouts, for example, are typically consumed as a salad, and most of their sprouts are fluffy, crunchy, and sweet. Sprouts are the young seedlings produced by seed germination; they have been used as vegetables for thousands of years and have recently gained popularity in Western countries as a functional food. Protein, minerals, vitamins are all abundant in sprout (Almuhayawi *et a*l., 2021).

6.3 Optimum Environmental Conditions for Germination and Growth of Alfalfa

The development of alfalfa seedlings is influenced by temperature and photo period (day length) which have an impact on growth rate, stem initiation, and the allocation of photosynthesis to root and stem development. The best time to plant alfalfa can be predicted using meteorological records from a specific area and information on the responsiveness of alfalfa seedlings to temperature and day length. The chance of stand failure is reduced if the alfalfa plant is given as close to ideal development conditions as feasible (Mueller, 2019).

Alfalfa seed germinates best in soil temperatures ranging from 65°F (18.3°C) to 85°F (29.4°C). Alfalfa takes six days to germinate when the soil temperature is 40°F (4.44°C), two days when the temperature is 65°F (18.3°C). Studies has been conducted related to the alfalfa seedling growth and development in response to temperature and day length fluctuations, where they reported that the optimum temperature for root growth during the first month was between 69°F (20.56°C) and 76°F (24.44°C), depending on dormancy class (Teuber et al., 1980). Temperatures between 72°F (22.22°C) and 76°F (24.22°C) are ideal for shoot growth. When the air temperature falls below 34°F (1.11°C), alfalfa stops growing. The humidity needed for to grown alfalfa is between 75 and 80 percent. (Mueller, 2019).

6.4 Seeding method

Alfalfa is planted using one of the two methods; broadcast methods (including by aeroplane) or drill planted method. All these methods can produce effective stands when properly calibrated to achieve the required seeding rate and uniform planting

depth, and when employed in a well-prepared seedbed. Each of the methods has its own advantages and drawbacks. (Mueller, 2019)

6.4.1 Broadcast methods

Seeders of various varieties are often used to evenly distribute seed over the soil surface. Because it has a roller in front to firm the soil and a roller trailing behind the seed drop to cover and press the seed into the soil at an ideal depth, a cultipacker seeder (billion seeder) does an outstanding job of planting alfalfa. Seed may be dispersed evenly over the soil surface using air-flow ground applicators, which can also be utilized for other tasks like fertilizer application (Mueller, 2019).

Another technique known as fluid or suspension seeding is also available. This involves planting of seeds by air, and it is a good option for big acreages or when the soil is too moist to support ground equipment. Although air-planting of seed is the most cost-effective option, but it has drawbacks. Flying seed onto a field may necessitate more seed, cause more skips, and give you less control over seed depth. Seed must be coated after broadcast seeding with all broadcast methods except the brillion seeder. This is when a cultipacker or ring roller comes in handy. Firming the soil around the seed increases moisture contact and improves germination.

A spike-toothed harrow typically integrates seed into the top 3 inches of soil, which is too deep for optimal emergence, and is hence not advised (Mueller, 2019).

To enhance germination and emergence, the seed must be covered with soil. Most broadcast systems do not perfectly control planting depth, resulting in some seeds being too deep and others being too shallow, necessitating higher seeding rates (Mueller, 2019).

6.4.2 Drill methods

Grain drills, also known as band seeders, can be used to successfully establish alfalfa by placing seed in rows at a uniform depth. Press wheels or a corrugated roller usually cover seed that falls behind a disc opener. Drills with better depth control should be adjusted carefully for seeding depth to be uniform. The unplanted gap between rows, which provides an open area for weed invasion, is one disadvantage of drilling method as compared to broadcast seeding. To avoid massive skips caused by planter issues, some growers drill in two directions, perpendicular to each other. After planting, the seed must be covered and the soil firmed around it, much like with broadcast seeding. This can be done with the planter's press wheels, by pulling a cultipacker behind the planter, or in a separate operation (Mueller, 2019).

6.5 Hydroponic System

Many studies have been carried out in order to improve food producing methods. Soilless farming systems are one of them. Developments in soilless systems, such as aquaponics and hydroponics, can help farmers save money on resources especially production cost. Plant roots are floating in nutrient-rich water in a hydroponics system, allowing them to thrive without the need of chemicals. Both home gardeners and commercial vegetable growers can benefit from the ability to grow food in regions where traditional soil systems are not feasible or cost-effective. Plants in a hydroponic system can produce 20–25 percent more yields than those in a soil-based system, with 2–5 times the productivity (Rajkowski & Thayer, 2001).

Maeva Makendi's work in 2014 revealed a competitive analysis between plant development in hydroponic and soil systems. The finding shows that all the hydroponic plants germinated and grew. All the soil plants except for basil, carrots, lettuce, habanero peppers and brand name spinach did not germinate. In addition, the hydroponically grown plants germinated and grew at a rapid rate compared to the plants grown in soil. Other than the kale, parsley and watermelon all the remaining plants grown in the hydroponic system grew faster and taller than those that were grown in soil. "If hydroponic plants and plants grown in soil are given the same germination and growing conditions, hydroponic plants will do as well as, if not better than, plants grown in soil," the hypothesis claimed (Gashgari *et al*., 2018)

7.0 Methodology

7.1 Germination of alfalfa sprout

7.1.1 Materials and equipment

Several materials and equipment were necessary during this project or experiment: alfalfa seed, a plastic container with a lid, a kitchen weighing balance, a humidity, and temperature device, white vinegar, and water.

7.2 Method of Planting

Hydroponic techniques were chosen to germinate the alfalfa seed into the alfalfa sprout.

7.2.1 Germination step procedure

7.2.1.1 Germination and plantation direct on sponge

40g of alfalfa seed was placed in a plastic container and soaked in the water for 4 hours. Meanwhile, the sponge was put in the seed tray that had water in it and let the sponge inside the water for 5 minutes to complete the process of water absorption. After 5 minutes, the remaining water was removed from the seed tray. The sponge was put back in the seed tray, and after 4 hours, the alfalfa seed was sprinkled on the sponge surfaced. The seed was sprayed with water three times per day to maintain moisture for the germination process. The same step was repeated by adding one step, which was soaking the alfalfa seed in the vinegar for 10 minutes after 4 hours soaking process with water.

7.2.1.2 Germination and plantation using jar

40g of alfalfa seed was placed into a plastic jar. Then, plenty of water was added to the container, and let the seed soaking in the water for 4 hours. The amount of water added to the container was variable, and the important thing during this soaking process was to make sure all of the seeds sank into the water. After that, the water was removed from the jar, and the alfalfa seeds were washed several times with clean water. Then the seed was flushed every 8 hours a day, and the container that contained the seed was tilted to ensure all excess water was removed. The container was kept in the dark location to promote germination.

The same step was repeated by adding one step, which was soaking the alfalfa seed in the vinegar for 10 minutes after 4 hours soaking process with water. After 4 hours, one tablespoon of white vinegar was added to the same container that contained the alfalfa seed. The seed was stirred using a spatula to mix all the ingredients thoroughly and was set aside for 10 minutes.

7.2.2 Environmental condition

The environmental condition was observed and recorded three times per day which was on the morning, afternoon, and night using a digital LCD indoor-outdoor room electronic temperature humidity meter. The result was discussed later.

7.3 Harvesting

The alfalfa sprout was harvested when the height of the sprout was about 7cm.

7.3.1 Processing Alfalfa Sprout and Storage

After the height of the alfalfa sprout reached about 7cm in the container, the sprout was directly stored in the refrigerator at a temperature of 4°C, and the reasonable amount of dry alfalfa sprout was kept in the medium-sized plastic storage seal bag or airtight container to maintain the freshness. The alfalfa sprout was considered clean and not rinsed under cold water due to the planting process during the germination and sprouted of the alfalfa. The container that contained the sprout was rinsed daily. Therefore, it can be directly stored in a cold place.

One day before the usage, the alfalfa sprout was put under sunlight to remove the moisture for 6 hours. The length of the drying was monitored thoroughly to prevent the burning of alfalfa sprouts due to excessive exposure to sunlight.

7.4 Growth Performance of New Zealand White Rabbit

7.4.1 Feeding phase

An experiment with rabbits was carried out at University Malaysia Kelantan (UMK). The UMK Animal Care and Use Ethics Committee approved all animal handling and procedures. (UMK/FPV/ACUE/FYP/004/2022)

Eight (8) healthy rabbits were used for this study, and 8 of them were divided into two (2) groups are control group (Group A) and the experimental group (Group B). Group A was fed with a commercial rabbit pellet, and Group B was fed with the alfalfa sprout planted under a hydroponic system in Malaysia's environmental condition. The rabbits' weight was recorded at the starting age of 28 days, and it was recorded daily for 21 days in the morning.

The amount of alfalfa sprout fed to the rabbits in Group B and commercial rabbit pellet for the rabbits in Group A was 6% of their body weight. The quantities of feed were adjusted daily based on body weight. Water was supplied ad libitum in a water container. The rabbits were fed twice daily in the morning and evening.

Table 7.2.1.1: Division of Group

GROUP A				GROUP B			
Rabbit 1	Rabbit 2	Rabbit 3	Rabbit 4	Rabbit A	Rabbit B	Rabbit C	Rabbit D
Fed with commercial rabbit pellet				Fed with dry alfalfa sprout growing by using hydroponic system.			

7.4.2 Growth Performance Inspection

The rabbits' weight was recorded daily in the morning before their first meal using a weighing balance for 21 days. The percentage indifference of the total weight gain in both groups was observed at the end of the experiment. The total growth performance was evaluated by comparing initial weight on day-0 and final weight on day-21.

7.5 Data Analysis

The data for the environmental condition which consist of environmental temperature and humidity was interpreted by the direct interpretation which tables are used to represent statistical data by placing them in rows and columns. An independent T test was used to analyse the input determine the type of diet given and the growth performance of the New Zealand White rabbit in this study. The test were performed using the SPSS Version 27 software.

8.0 Results

8.1 Environmental Condition for Germination of Alfalfa Sprout in Malaysia

Several batch of alfalfa seed has been germinated accordingly under Malaysia environmental condition. The temperature and humidity were recorded three (3) times per day which were at the morning, afternoon and nighttime using humidity and temperature measure device. Table below shows the average temperature, humidity and height of several production of the alfalfa sprout.

The germination of alfalfa sprout according to Malaysia environmental condition has been proved in this project which the alfalfa sprout begin to germinate at temperature within minimum temperature of 28℃ and maximum temperature of 28.9℃ when it was germinated under hydroponic condition. The humidity observed for the germination of alfalfa sprout in this project was between 80% to 83%. Based on this project, the duration for the length of the alfalfa sprout to reach requirement height for it to be harvested which are minimum height of 7.5cm and maximum height of 8.0cm was 5 days. (Table 8.1.1, Table 8.1.2, Table 8.1.3, Table 8.1.4, & Table 8.1.5)

Table 8.1.1: Batch 1 Environmental Condition

DAY	TEMPERATURE (℃)	HUMIDITY (%)	HEIGHT (cm)
1	28.3	83	0
2	28.1	81	0.3
3	28.2	83	4
4	28.3	82	7
5	28	80	7.5

Table 8.1.2: Batch 2 Environmental Condition

DAY	TEMPERATURE (℃)	HUMIDITY (%)	HEIGHT (cm)
1	28.2	80	0
2	28.4	83	0.5
3	28.1	82	4.5
4	28	81	7.5
5	28.2	83	8

Table 8.1.3: Batch 3 Environmental Condition

DAY	TEMPERATURE (℃)	HUMIDITY (%)	HEIGHT (cm)
1	28.8	80	0
2	28.9	80	1
3	28.6	80	3
4	28.5	82	6
5	28.7	82	8

Table 8.1.4: Batch 4 Environmental Condition

DAY	TEMPERATURE (℃)	HUMIDITY (%)	HEIGHT (cm)
1	28.8	80	0
2	28.9	82	1
3	28.3	80	2
4	28.5	81	6
5	28.1	82	7.5

Table 8.1.5: Batch 5 Environmental Condition

DAY	TEMPERATURE (℃)	HUMIDITY (%)	HEIGHT (cm)
1	28.3	83	0
2	28.8	82	1
3	28.3	81	3
4	28.5	81	6
5	28.1	82	8

During the studies, some problems has been faced which were the harvested weight of alfalfa sprout was not sufficient to accommodate the feeding of rabbits when it is planted under direct germination and planting on sponge, thus two method of planting was established during the ongoing research. Table 8.2 shows that germination and planting in a jar produced more harvested alfalfa sprout when compared with direct germination and planting on sponge.

Table 8.2: Method of Planting and Weight of Alfalfa Sprout Harvested

BATCH	METHOD OF PLANTING	WEIGHT OF SEED (g)	WEIGHT HARVEST (g)
1	Direct germination and planting on sponge	40	25
2	Direct germination and planting on sponge	40	45
3	Germination and planting in jar	40	175
4	Germination and planting in jar	40	275
5	Germination and planting in jar	40	300

During the studies, there was presence of mold formation in the batch 1 of alfalfa sprout. Therefore, to overcome this problem, a method was established by usage of white vinegar during the soaking process. Table 8.3 shows that majority of the batch that used white vinegar, there were absence of mold formation.

Table 8.3: Usage of White Vinegar and Mold Formation

BATCH	Usage of White Vinegar	Mold Formation
1	Not use	Presence
2	Use	Presence
3	Use	Absence
4	Use	Absence
5	Use	Absence

8.4 Feeding phase of the rabbits

An experiment with rabbits were carried out in University Malaysia Kelantan (UMK). All animal handling and procedures were approved by the UMK Animal Care and Use Ethics Committee. (UMK/FPV/ACUE/FYP/004/2022)

The experiment was conducted for 21 days using eight female weaned New Zealand White Rabbit, about 28 days of age, which were obtained from local supplier, which is Kulim Agrotech located in Wakaf Bharu, Kelantan. Rabbits with initial average body weight ±474g-565g were recorded. All rabbits were divided into two dietary groups consisting of 4 rabbits for each group.

The initial and final weight of the rabbits in both groups were recorded and the difference in weight gain between both group were observed and tabulated in the table below.

Both of the groups shows increase in weight gain. (Table 8.4.1 & Table 8.4.2) However, it is significant that growth performance in group of rabbit fed with pellet was more than the group of rabbit fed with alfalfa sprout. (Table 8.4.3)

Table 8.4.1: Weight of the Control Group Rabbit

RABBIT ID	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	WEIGHT GAIN (g)
1	467	1085	618
2	427	971	544
3	396	928	532
4	437	983	546

Table 8.4.2: Weight of the Experimental Group Rabbit

RABBIT ID	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	WEIGHT GAIN (g)
A	539	850	311
B	575	1200	625
C	560	900	340
D	596	1100	504

Table 8.4.3: Growth Performance of rabbit in Control and Experimental Group

GROUP	TOTAL WEIGHT GAIN (kg)	DIFFERENCE (kg)	Mean ± Standard Deviation (SD)	*p*-value
CONTROL	2.24	0.46	560 ± 39.1^{b}	0.02
EXPERIMENTAL	1.78		445 ± 147^{a}	

9.0 Discussion

The germination of alfalfa sprout according to Malaysia environmental condition has been proved in this project which the alfalfa sprout begin to germinate at temperature within minimum temperature of 28℃ and maximum temperature of 28.9℃ when it was germinated under hydroponic condition. Temperature is a crucial parameter that can determine the germination of the seed is a failure or success process. Even though the mean temperature in topical country such as Malaysia is 32℃ (Wong et al., 2018), however during this project was conducted, it was rainy season, thus it affects the value of the temperature which it does not exceed 30℃. According to Mueller 2019, Alfalfa seed germinates best in soil temperatures ranging from 18.3°C to 29.4°C. Even though this project uses hydroponic system to germinates the alfalfa seed, the temperature observed is still within the range which is it does not exceed 29.4°C.

The humidity observed for the germination of alfalfa sprout in this project was between 80% to 83%. According to Mueller 2019, the humidity needed to grow alfalfa is between 75 and 80 percent. Therefore, it can be concluded that 3% increment of the humidity parameter would not affect the germination of the alfalfa sprout as the alfalfa sprout still germinated and shows increase in height every day prior to harvesting even though the humidity reach 83%.

Based on this project, the duration for the length of the alfalfa sprout to reach requirement height for it to be harvest which are minimum height of 7.5cm and maximum height of 8.0cm was 5 days compared to the barley sprout grown in a hydroponic system which need 8 days to grow with minimum harvested height of

6.0 cm and maximum harvested height of 10.0cm (Emam M. S. A, 2016) Therefore, alfalfa sprout has shorter duration of harvesting compared to the barley sprout which means alfalfa sprout was considered the best choice that can be used for the production of hydroponic fodder with less time-wasting.

Other than that, method of planting also shows significant impact on the amount or weight of alfalfa sprout harvested. When the alfalfa sprout was grown via direct germination and planting on sponge, the weight of the alfalfa sprout harvested was less than the weight of the alfalfa sprout grown using jar. The production of the alfalfa sprout using direct methods also tend to develop mold compared to the alfalfa sprout that has been produced in the jar.

The weight of the alfalfa sprout after harvested was difference according to the method of germination and plantation might be due to exposure of the seed directly towards the environment. During germination and plantation via direct method, the sponge uses as a medium for the seed to germinates develop bad odour which it occurs due to accumulation of water at the bottom of the sponge. As a result, the surface of the sponge become dry and affect the germination rate of the seed as the condition was too dry. The production of the alfalfa sprout that use the direct method also had mold formation which it is believed to occur due to the accumulation of the water at the bottom of the sponge which led to the mold formation.

However, the weight of the harvested alfalfa sprout was increased by 28% even with the evidence of mold formation with the usage of white vinegar during the soaking process. It is believed that by soaking alfalfa seed in the white vinegar initially help to prevent or reduced the formation of mold during the growing process. This

finding was like the research done by Sholberg et al., 2000 which the usage of vinegar can effectively inactivated the development of fungi in several fruits.

In addition, the method of germination and plantation of the alfalfa sprout using jar with the usage of white vinegar during the soaking process was considered the best way based on this study as this established method was proven to be able to produce a high amount of harvested alfalfa sprout within 5 days period. The usage of white vinegar and daily rinsing of the jar that contains the growing alfalfa sprout was believed to be a factor that prevents the mold from growing.

The harvested alfalfa sprout that has been grown in a hydroponic system was fed to the rabbits in experimental group and all rabbits in the group showing weight gain which proved that feeding the rabbits solely with alfalfa sprout also have positive outcome towards the weight gain of the rabbits. Indirectly, it was proven that alfalfa sprout has enough nutritive values which can contributes to the growth performance of the New Zealand White rabbits.

When compared with the rabbits in the control group which it was fed with pellets, they have higher total weight gain than rabbits in the experimental group but with a minor difference which was only 11% differences in terms of the total weight gain. However, it was significant that pellet contributed more towards the weight gain of the rabbits. Therefore, based on this studies, we can suggest to give alfalfa sprout together with commercial feed because this may reduce the budget for pellet consumption in rabbit industry.

10.0 Conclusion

In conclusion, the alfalfa sprout was grown via a hydroponic system in Malaysia's environmental conditions and had high yield production when germinated and planted according to the correct methods. Furthermore, we can conclude that growth performance of rabbits which was evaluated based on weight gain, was higher in group fed with commercial feed.. However, this studies shows that feeding rabbits with the alfalfa sprouts based on the requirement has ability to help increase the growth performance as the rabbits also showed an increase in weight gain when fed with alfalfa sprouts.

11.0 Recommendation

Several limitations were observed in this study. Firstly, the production of the alfalfa sprouts was higher due to demand during the feeding process. Therefore, several batches of production need to be done simultaneously to meet the demand. However, during the germination process and plantation of the alfalfa sprout, some production was contaminated with mold formation. For future studies, it is wise to increase the production in a more powerful medium and find effective and less time-consuming ways to prevent mold formation. Other than that, for future studies, it is advisable to send the alfalfa sprouts sample for nutritional analysis to get valid nutritive values, which will be an indicator for other researchers who want to observe the nutritive values of alfalfa sprouts grown in a hydroponic condition. Even though this study shows an increase in growth performance of New Zealand White rabbits fed with alfalfa sprouts which indirectly shows that alfalfa sprouts provide reasonable nutritional requirements, it is best to get the proximate analysis of the alfalfa sprouts to evaluate their nutritive values.

Appendix A

Appendix A.1: The germination and plantation of alfalfa sprout using plastic jar

Appendix A.2: Direct germination and plantation on sponge

Appendix A.3: Harvested alfalfa sprout after 5 days

Appendix B

Appendix B.1: A cage with experimental group of New Zealand White rabbits during feeding time of alfalfa sprouts

Appendix B.2: Rabbit A was eating the alfalfa sprout

Appendix B.3: Weighing process of the rabbits

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