JOURNAL OF AGROBIOTECHNOLOGY 2022, VOL 13(1S):24-30.
e-ISSN: 2180-1983
http://dx.doi.org/10.37231/jab.2022.13.1S.315
https://journal.unisza.edu.my/agrobiotechnology/index.php/agrobiotechnology/index

Study on Chemical Composition of Napier Pak Chong (*Pennisetum purpureum x Pennisetum glaucum*) Harvested at Different Growth Stages

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Received: 31/07/2022, Accepted: 08/09/2022 Available Online: 16/10/2022

ABSTRACT

Napier Pak Chong is a new hybrid crossing *Pennisetum purpureum* and *Pennisetum glaucum* known as Pearl Millet Napier. The Napier Pak Chong grass has been introduced due to its high nutritional contents, particularly in terms of crude protein compared to other napier grass varieties. Therefore, the aims of this study were to determine the chemical composition of the Napier Pak Chong harvested at three different growth ages which are 45 days, 60 days and 75 days and to identify the best harvesting ages of the Napier Pak Chong grass. The samples were collected at Kaprima Hulu Seladang Valley Farm. Then, the samples were dried and ground before being analyzed using proximate analysis and mineral analysis using Induced Couple Plasma Optical Emission Spectrometry (ICP-OES). In the proximate analysis, the plant samples were analyzed to determine the percentage of moisture, ash, crude fibre (CF), crude protein (CP) and fat. For the mineral analysis, the samples were analyzed for magnesium, potassium, sodium, phosphorus and calcium. Results showed that the percentages of crude protein in the Napier Pak Chong grass decreased with increased harvesting ages meanwhile the crude fibre increased along with maturity. The percentage of crude protein is highest at 45 days which is 19.48%. The results also showed that the chemical compositions were highest at the early stage of harvesting, which is at 45 days. Thus, this study showed that the harvesting ages have an effect on the chemical composition of Napier Pak Chong grass.

Keywords: Napier Pak Chong, chemical composition, harvesting ages, ICP-OES

INTRODUCTION

Forages are a necessary component of diets for ruminants. Napier grass, *Pennisetum purpureum* has been the most promising and high-yielding fodder giving in dry matter yields. Selecting forage species for cultivation must take into consideration the yield, digestibility and nutrient composition. Napier or elephant grass (*P. purpureum*) was first introduced to Malaysia in the 1920s and several cultivars had been introduced since the conditions there is

a wide range of habits, yield potential and nutritive value. Napier grass is fast growing and has high annual productivity that depends on climatic and soil conditions (Rusdy, 2016).

Napier Pak Chong is a new hybrid crossing of *P. purpureum* (the ordinary napier grass) and *P. glaucum* known as Pearl Millet Napier. Napier Pak Chong grass has been introduced due to its high nutritional contents, particularly in terms of crude protein compared to other napier grass varieties, which is likely to positively impact the milk quality of dairy ruminants. It is claimed to contain 16% to 18% of crude protein, which is considered very high and great for milk-producing animals (Premaratne & Premalal, 2006). It is very fast-growing and high yielding. Malaysia is expected to grow more Napier Pak Chong grass by focusing on supplying feed, especially for dairy ruminants. It provides nutritive and palatable green fodder all year round, which contains 10 - 12 % of crude protein, 14.9 % dry matter (DM), 16.5 % protein, 35.8% Neutral Detergent Fibre (NDF), 14.5% ash and 36.5% soluble carbohydrate at the harvest time of 45 days (Pitaksinsuk et al., 2010).

Napier Pak Chong is smooth, juicy and very consumable grass high in moisture content, making this napier one of the preferred ingredients for animal food producers. The Napier Pak Chong is highly demanded from many countries as a significant food source to be consumed as animal feed. However, Napier Pak Chong (*P. purpureum x P. glaucum)* which is reported to grow over 3-meter-tall in less than two months, gives high yields and can be harvested after 45 days with a crude protein concentration of 16-18% (Berentsen et al., 2000). Nevertheless, forage crop performances are positively correlated with the area, location, and season (Tessema et al., 2010). Therefore, this study aims to determine the chemical compositions of Napier Pak Chong harvested at three different growth ages. This study revealed that Napier Pak Chong grass with the best harvesting ages.

MATERIALS AND METHODS

Source of plant materials

The stem cutting of Napier Pak Chong was collected at Heritage Agro Farm Enterprise, Hulu Terengganu and was transferred to the Kaprima Hulu Seladang Valley Farm at Setiu, Terengganu.

Experimental design

The planting site of this study was conducted at Kaprima Hulu Seladang Valley Farm (5^{o} 46.0316' N, 102^{o} 37.9862' E) in Setiu, Terengganu. The grass was harvested at three different growth stages, which were 45 days, 60 days and 75 days. This study was conducted in three replicates for each row of crops. The samples for the study were arranged in a Randomized Complete Block Design (RCBD) as presented in Table 1.

Table 1. Experimental Design using Randomized Complete Block Design (RCBD)

Group	Days		
	45	**60**	**75**
Control	3 rows (3 replicates)	3 rows (3 replicates)	3 rows (3 replicates)
Treatment	3 rows (3 replicates)	3 rows (3 replicates)	3 rows (3 replicates)

Plant management and plant harvesting

The plots were ploughed with a tractor. There were 10 rows and each row measures 85 m. The spacing between the plant in each row was 2.0 m respectively. The parent plant stem with three nodes per cutting was planted 15 cm to 20 cm deep.

The weed control was carried out over 40 days. Napier Pak Chong grass was harvested at 45 days, 60 days and 75 days by cutting the stubble 5 cm above the ground level using the knife, and fresh stems and leaves of each three harvested plants of each row were separated. The plant samples were then put in zipper plastic bags and transferred to the Soil Science Laboratory of University Sultan Zainal Abidin (UniSZA), Besut campus for further analysis.

Sample preparation and chemical analysis

The sample of Napier Pak Chong was washed properly under tap water in less than 30 seconds to remove any debris and remaining soil. Then, the sample was put on the tray, chopped into small pieces and it was dried in an oven at 80°C for 48 hours (AOAC, 2005). The dried plant samples were ground by using Waring Blender to produce powdery samples. Then, samples were kept in the zip lock plastic bag to maintain their freshness and were labelled. The powdery samples were placed in a plastic bag and stored under cool and dry conditions at room temperature. The powdery samples were analysed for proximate analysis to determine the chemical compositions of moisture, ash, crude protein, crude fibre, and fat, as well as the mineral compositions for sodium, potassium, magnesium, calcium, and phosphorus content.

Statistical analysis

The collected data were analysed by One-way Variance (ANOVA) to determine significant differences between chemical compositions at different levels of growth stages (45 days, 60 days and 75 days) of Napier Pak Chong (*P. purpureum x P. glaucum*) by using SPSS 27.0 statistical software. The significant difference of data test was used to compare the difference between each treatment. The value of $p < 0.05$ was considered a significant difference.

RESULTS AND DISCUSSION

Proximate analysis

The proximate analysis results of this study show that the different harvesting ages which are 45 days, 60 days and 75 days have a significant effect on the percentages of all components of proximate analyses. The percentage of moisture, ash, crude protein and fat decreased as the age increased while the crude fibre increased as the age increased. The proximate compositions of Napier Pak Chong at three different harvesting ages were shown in Table 2.

Table 2. Proximate compositions of Napier Pak Chong at different harvesting ages.

Parameters (%)	Napier Pak Chong		
	Mean ± SD		
	45 days	60 days	75 days
Moisture	87.23 ± 2.09[a]	83.22± 2.08[b]	79.34± 2.06[c]
Ash	16.50± 1.23[a]	14.52± 1.52[b]	12.25± 1.05[c]
Crude Protein	19.48 ± 1.27[a]	17.27± 0.49[b]	15.87± 1.06[c]
Crude Fiber	25.66 ± 0.81[a]	29.22± 0.68[b]	32.40± 1.19[c]

Crude Fat	3.26± 0.19[a]	2.65± 0.22[b]	1.64± 0.22[c]
NFE	35.1± 0.06[a]	36.34± 0.03[b]	37.84± 0.14[c]

Note: All the results are presented as means ± standard deviation of the mean. [a,b,c] Means values labelled with different subscript letters are significantly different according to Tukey at $p < 0.05$.

The moisture content in Napier Pak Chong grass at different harvesting growth ages also showed a significant difference for mean values at level $p < 0.05$. The 45 days show the highest moisture content which is 87.23% followed by days 60 (83.22%) and days 75 (79.34%). The Napier Pak Chong showed higher moisture content at day 45 than the other stages. This result of moisture analysis obtained from this study was similar to the findings of Lounglawan et al. (2014) and Ansah et al. (2010) which are the percentage of moisture when cut at 45 days intervals was 88.63% while during the day 60 days intervals were 82.84%. The moisture content represents the amount of water in a material (Kahindi et al., 2007).

The mean value for ash content at different growth stages also showed that there is a significant difference at $p < 0.05$. The mean value of ash was the highest during day 45 which is 16.50% compared to the next harvesting ages. The ash content was decreased along with the maturity. This is similar to the findings of Lounglawan et al., (2014) and Ansah et al. (2010) which are the percentage of ash, when cutting 45 days interval, was 15.90% while for 60 days interval was 13.92%. The determination of ash content is important as it is total inorganic and indicated the minerals contents in the materials (McClements & Decker, 2009).

In terms of crude protein, it is an important component to produce high-quality feed. According to Pinkerton (2005), protein had been used as an indicator of forage quality. It is the essential amount for optimum health and animals. Based on the previous study by Aregheore (2006), it was reported that the range of crude protein in the forage range was 17% to 18% for harvesting at 45 days. The range of mean protein values in this study was 19.48% at 45 days. This result has differed from the findings of Aregheore (2006). According to Schut et al., (2010), the changes in the nutrient composition of plants were influenced by several factors including climate, season, weather, soil type and soil fertility. In this study, the mean value of crude protein was the highest during day 45 for both Napier Pak Chong. This shows that crude protein percentage decreased along with maturity. This result was similar to the findings of Gomide et al. (1969) who stated that the crude protein content decreased as the grass age increased.

In terms of crude fibre, the percentages increased as the age increased. The lowest percentages were during day 45 for Napier Pak Chong with 25.66%. Based on a previous study by Tessema et al. (2010), the intervals between harvests led to the accumulation of fibre and quality reduction due to an increase in cell wall carbohydrates that increased along with maturity which also caused the crude protein to decline (Soest, 2018). The percentage of crude fibre in regard to harvesting ages is the reverse of the protein percentage. The lower percentages of crude fibre at early harvesting also mean that the grasses are desirable as animal feed (Dudley et al., 1973).

Fat is a group substance that is soluble in ether, chloroform or other organics solvent but insoluble in water (Min et al., 2010). The percentages of crude fat content in the Napier Pak Chong were highest on days 45 which is 3.26% and the lowest on days 75 which is 1.64%. There is a significant difference in the mean values of fat of Napier Pak Chong at level $p < 0.05$.

Nutritional quality is influenced by management practices and harvesting ages (Islam et al., 2003). The nutritional qualities of forages are also influenced by several factors such as the climate (Keba et al., 2013). In order to maximize both yield and nutritional qualities, great care adapts to growing napier grass. This practice can increase the nutritive value of napier grass as feed.

Mineral analysis

Table 3 shows the mineral analysis results of Napier Pak Chong at different cutting ages. The results show that there is a significant difference ($p < 0.05$) in Potassium, Calcium, Phosphorus and Sodium content along the cutting ages, which are 45 days, 60 days and 75 days. The mineral contents of K, Ca, P and Na decreased as cutting ages increased while the potassium increased as the cutting ages increased.

Table 3. Mineral composition of Napier Pak Chong at different harvesting ages

Parameters (%)	Napier Pak Chong		
	Mean ± SD		
	45 days	60 days	75 days
Magnesium	1810.33± 47.67[a]	2237.16± 43.47[b]	3052.75± 40.15[c]
Phosphorus	1359.26± 39.24[a]	1169.22± 43.39[b]	1064.69± 35.73[c]
Potassium	19771.62± 163.14[a]	17426.03± 285.82[b]	16171.70±74.55[c]
Calcium	2652.79± 200.20[a]	3424.80± 96.04[b]	2977.32± 48.52[c]
Sodium	579.32± 31.85[a]	571.63± 20.24[b]	399.51± 25.72[c]

Note: All the results are presented as means ± standard deviation of the mean. [a,b,c] Means values labelled with different subscript letters are significantly different according to Tukey at $p < 0.05$.

Magnesium is important in livestock as it acts as the cofactor or the most enzyme in the body (Karimi et al., 2012). Magnesium is required as a cofactor in many enzymes involved in energy transport, particularly those utilizing ATP (Gaál et al., 2004). Results show that there is a significant difference in Mg content among three harvesting ages, $p < 0.05$. Magnesium content was higher at 75 days (3052.75 ppm) compared to 60 days and 75 days. The Mg content was increased along with the findings of Karimi et al. (2012) found that the mineral compositions in plants decreased along with maturity.

Phosphorus is important in the formation of teeth and bones in the body. The results showed that there is a significant difference in phosphorus content among the three harvesting ages ($p<0.05$). The results showed that the phosphorus content was higher at 45 days (1359.26 ppm) compared to other harvesting ages. The phosphorus content decreased as the harvesting age increased. This result was similar to the findings of Karimi et al. (2012), which showed that the mineral content decreased along with maturity. Moreover, Suttle (2010) also stated that the phosphorus content of napier grass decreased with maturity.

The results showed that there is a significant difference in potassium content among three harvesting ages for Napier Pak Chong. The result showed that the potassium content was higher at 45 days (19771.62 ppm) compared to 60 days and 75 days. While the potassium was above 8000 ppm, it is recommended for grazing animals at all stages of maturity (McIvor, 2007).

Calcium is an important mineral in the body which supports the skeleton structure and function. The results showed that there is a significant difference in calcium content among the three harvesting ages. The results showed that calcium content increased from 45 days until 60 days and decreased at 75 days. Meanwhile, for Sodium, day 75 indicated the lowest content of composition for Napier Pak Chong. There is no significant difference between the content of Sodium elements on day 45 and day 60 with 579.32 ppm and 571.63 ppm, respectively.

CONCLUSION

This study has revealed that Napier Pak Chong grass (*P. purpureum* × *P. glaucum*) with different cutting ages has a significant effect on the chemical composition. The moisture content, ash, crude protein and fat showed a

decrease in their percentage when harvesting ages were increased. The mineral analysis of phosphorus, potassium, sodium and calcium decreased when harvesting ages were increased. Thus, 45 days is the best harvesting age for Napier Pak Chong grass which contains the highest chemical.

ACKNOWLEDGEMENTS

This study was supported by the Fundamental Research Grant Scheme FRGS/1/2019/WAB01/UNISZA/02/4/ (RR312) by the Ministry of Higher Education, Malaysia (MOHE).

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How to cite this paper:
Mohamad, S. S. S., Kamaruddin, N. A. & Ting, J. Y. (2022). Study on chemical composition of Napier Pak Chong (*Pennisetum purpureum x Pennisetum glaucum*) harvested at different growth stages. *Journal of Agrobiotechnology, 13*(1S), 24-30.