# การศึกษาการใช้หญ้าเนเปียร์ในอาหารปลานิล (*Oreochromis niloticus*)

# Study on the Use of Napier Grass in Tilapia (*Oreochromis niloticus*) Diet

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## บทคัดย่อ

การศึกษาการใช้หญ้าเนเปียร์ในอาหารปลานิล มีวัตถุประสงค์เพื่อพัฒนาอาหารในการเลี้ยงปลานิลจากหญ้าเนเปียร์ และเพื่อเปรียบเทียบประสิทธิภาพของอาหารแต่ละสูตรในการเลี้ยงปลานิลการใช้หญ้าเนเปียร์ในการเลี้ยงปลานิล โดยใช้แผนการทดลองแบบสุ่มสมบูรณ์ ด้วยกระบวนการผสมสูตรอาหารที่ต่างกัน 4 ชุดการทดลอง ชุดการทดลองละ 3 ซ้ำ ได้แก่ สูตรที่1 อาหารสำเร็จรูป 100 % สูตรที่ 2: อาหารสำเร็จรูป: หญ้าเนเปียร์: รำละเอียด: 50%: 30%: 20% สูตรที่ 3: อาหารสำเร็จรูป: หญ้าเนเปียร์: รำละเอียด: 30%: 50%: 20% และ สูตรที่ 4: อาหารสำเร็จรูป: หญ้าเนเปียร์: รำละเอียด: 0%: 80%: 20% ในบ่อซีเมนต์ขนาดเส้นผ่าศูนย์กลาง 0.78 เมตร สูง 50 เซนติเมตร จำนวน 12 บ่อ อัตราการปล่อย 30 ตัวต่อบ่อ เป็นระยะเวลา 12 สัปดาห์ ซึ่งมีผลดังนี้ ด้านน้ำหนัก ในสูตรที่ 1 มีน้ำหนักเฉลี่ยมากที่สุดคือ 305.5 กรัม รองลงมาคือ สูตรที่ 2 สูตรที่ 3 และสูตรที่ 4 เท่ากับ 305.2 ก. 303.3 ก. และ 302.8 ก. ตามลำดับ ซึ่งแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p<0.05$) ด้านอัตราการแลกเนื้อ สูตรที่ 1 มีอัตราการแลกเนื้อดีที่สุด คือ 2.57 รองลงมาคือสูตรที่ 3 สูตรที่ 2 และ สูตรที่ 4 เท่ากับ 2.58, 2.59 และ 2.59 ตามลำดับ ซึ่งแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p<0.05$) ด้านอัตราการรอด สูตรที่ 4 มีอัตราการรอดมากที่สุด ร้อยละ 95.56 รองลงมาคือ สูตรที่ 3 สูตรที่ 2 และสูตรที่ 1 เท่ากับ ร้อยละ 94.44, 92.22 และ 91.22 ตามลำดับ ซึ่งแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p<0.05$) และด้านต้นทุนค่าอาหารต่อกิโลกรัม สูตรที่ 4 มีต้นทุนต่ำที่สุด คือ 2.28 บาท/กก. รองลงมาคือ สูตรที่ 3 สูตรที่ 2 และสูตรที่ 1 เท่ากับ 7.05, 10.23 และ 17.50 บาท/กก. ตามลำดับ ซึ่งมีความแตกต่างกัน

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อย่างมีนัยสำคัญทางสถิติ ($p<0.05$) จากผลการทดลองสามารถนำหญ้าเนเปียร์มาเสริมในอาหารปลานิลได้สูงสุดถึง 80 % และสามารถลดต้นทุนการเลี้ยงปลานิลได้
**คำสำคัญ**: ปลานิล หญ้าเนเปียร์ สมรรถภาพการเติบโต

## Abstract

The use of Napier grass for tilapia diet (*Oreochromis niloticus*) to compare each feed formula's efficiency in tilapia culture was studied. This study used a Completely Randomized Design (CRD) with 4 different feed formula mixing processes, 3 replications, namely Treatment1 : 100 % commercial feed, Treatment 2: commercial feed: Napier grass: rice bran: 50%: 30%: 20%, Treatment 3 : commercial feed: Napier grass: rice bran: 30%: 50%: 20% and Treatment4 : commercial feed: Napier grass: rice bran: 0%: 80%: 20%. Tilapia was cultured in 12cement ponds with a diameter of 0. 78m, a height of 50cm, with a stock density of 30 fish per pond for 12weeks. Which has the following results: weight: in T1, the average weight of tilapia was 305.5 g. followed by T2, T3, and T4; the formula had weights of 305.2 g, 303.3 g, and 302.8 g, respectively, which were significantly different ($p<0.05$). The best feed conversion ratio, it found that T1 was 2.57, followed by T3, T2, and T4 were 2.58, 2.59, and 2.59, respectively which were significantly different ($p<0.05$). In terms of survival rate, it found that T4, tilapia had the highest survival rate of 95.56%, followed by T3, T2, and T1 were 94.44, 92.22 and 91.22 %, respectively, which were significantly different ($p<0.05$). It found that formula 4 had the lowest cost of 2.28 baht/kg, followed by formula 3, formula 2, and formula 1 at 7.05, 10.23, and 17.50 baht/kg, respectively, which were statistical significance ($p<0.05$). From the experimental results, Napier grass can be added to the tilapia diet up to 80% and can reduce the cost of raising tilapia.
**Keywords**: Tilapia, Napier grass, growth performance

### Introduction

Tilapia *(Oreochromis niloticus)* is a freshwater fish that is economically valuable, easy to grow, fast-growing, and popular with consumers. Nowadays, farmers are widely the culture of tilapia - most tilapia cultures in Thailand are pond and cage cultures. Only a tiny percentage are cultured in paddy fields and waterways of the orchard (Wiwattanachaiset and Kraibutr, 2000). Currently, tilapia farming costs about 60-80 % of the total production cost. (Intharamat, 2010). Ready commercial tilapia feed sold in the market at a protein level of 30 % costs about 26.38 baht per kilogram (Department of Fisheries, 2017). However, tilapia is an omnivorous

fish. Therefore, plant-proteins can help tilapia grow (Tangtrongpairote et al., 1993). Herbivore fish digest carbohydrates better than carnivorous fish. The raw materials often included in the commercial fish feed include a fish meal and the digestible plant protein for fish. Napier grass is one of the forage crops that are widely used by farmers today because of its fast-growing, high yield, high protein, and nutrition, suitable for animal feed (Keawtong, 2013). Napier grass has complete animal nutrition. Therefore, this research is an experiment to use Napier grass species Pak Chong 1 as raw material to replace expensive protein sources in the production of tilapia feed because Napier grass strain-type Pak Chong 1 is a strain with high protein levels and is a forage crop that produces higher yields than other grass species (Sukchit, 20 1 7 ). Testing of tilapia culture in Rayong Province with Napier grass strain-type Pak Chong 1 in cement ponds with different fish feed formulas showed that it could help reduce the feed cost for fish culture. In addition, the nutritional value of Napier grass strain-type Pak Chong 1 compared to other grass species has higher protein and ash than other grass species (Khiaothong, 2011).

The use of Napier grass for tilapia diet *(Oreochromis niloticus)* to develop feed for tilapia culture from Napier grass and compare the efficiency of each feed formula in tilapia culture.

## Materials and methods

### Experimental design

A completely randomized design (CRD) Was planned with 4 treatments and 3 replications, treatment 1 (T1) was 100% commercial feed, Treatment 2 (T2) was commercial feed: Napier grass: rice bran: 50%: 30%: 20%, Treatment 3 (T3) was commercial feed: Napier grass: rice bran: 30%: 50%: 20% and Treatment 4 (T4) was commercial feed: Napier grass: rice bran: 0%: 80%: 20%.

State the ratio of each feed component to make it more understandable and standard.

### Fish experiment

Tilapia juveniles were reared in cement ponds prior to the start of the experiment to acclimate the fish to food and environment for 7 days. Commercial feed protein not less than 30%. fed by giving 5% body weight per day, twice a day, morning and evening, then randomly counting the fry. The average starting weight was 11.65 ± 0.48 g, and the average starting standard length was 7.18 ± 0.05 cm into the prepared cement pond, size 0.78 m in diameter, with a stock density of 30 fish per pond (38.64 fish/$m^2$).

### Fish pond preparation

The experimental cement ponds were a diameter of 0.78 m and a height of 50 cm, with a drains system to water exchange. Pond preparation before raising fish, clean, soak in lime for a night and release all water from the pond. Then, leave it dry in the sun for 7 days. Then the pond was cleaned, and the water condition was checked to neutralize the effect of the cement ponds. The water used for raising was tap water, leaving the water for 5 days before use and adjusting the water quality for raising tilapia with a pH of 6.5-7.5, suitable for fish culture experiments in all 12 ponds. (Intharamat, 2010)

**Fish feed preparation**

The experimental fish feeds were prepared by finely chopping Napier grass into a grinder and mixing the ingredients according to the proportions of each recipe. Pellets were then prepared using a pellet machine to the following formula, namely T1 : 100% commercial feed, T2 : commercial feed : Napier grass : rice bran: 50 : 30 : 20, T3 : commercial feed : Napier grass : rice bran : 30 : 50 : 20 and T4 : commercial feed : Napier grass : rice bran : 0 : 80 : 20.

**Feeding**

The four experimental feeds were fed to the tilapia at 5% of body weight per day, twice per day (8:00 and 17:00) for a period of 12 weeks.

**Sampling**

Fish samples were collected every 7 days in all experimental ponds at 10 samples per pond for the collected weight and standard length. Results were recorded and averaged for each of the 12 weeks.

**Data collection**

1. Weight gain (g) = The average weight of the fish after the experiment – Average weight of fish before experiment

2. Increased length (cm) =The length of the fish after the experiment – The average length of the fish before the experiment

3. Survival rate (percentage) = $\frac{\text{number of Survival fish}}{\text{Number of fish at the start of the experiment}} \times 100$

4. Feed Conservation Ratio (FCR) = $\frac{\text{Feed in take}}{\text{Weight gain}}$

5. Feed cost was calculated from the price of the raw materials of each recipe and compared the cost of each feed formula to produce 1 kg of fish.

**Data analysis**

The experimental results were analyzed by statistical differentiation using the Analysis of Variance method according to the CRD experimental design and comparing the mean difference between the control feed and the 4 feed formulas—Duncan's new multiple range tests at a 95 percent confidence level with a statistical Software package

## Results and Discussion

### Weight gain of Tilapia

From the study of the experimental results of using Napier Pak chong 1 grass in tilapia culture was found. In T1 (100% commercial feed), tilapia had the highest average weight gain of tilapia at 305.5 g, followed by T2 (commercial feed: Napier grass: rice bran 50: 30 : 20), T3 (30: 50: 20) and T4 (0: 80: 20) with average weight gain of tilapia 305.2 g, 303.3 g, and 302.8 g, respectively. There was statistically significant difference between all treatments ($p<0.05$), as shown in Table 1.

**Table 1** The average weight of tilapia (g) fed with different level of Napier for 12 weeks.

| Period (week) | weight of tilapia (g) | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | SEM | P-value |
| 0 | 11.0 | 12.1 | 11.6 | 11.9 | 1.00 | 0.32 |
| 1 | 36.2 | 37.3 | 36.7 | 36.8 | 1.22 | 0.50 |
| 2 | 60.6 | 61.5 | 60.9 | 61.0 | 1.28 | 0.61 |
| 3 | 90.3 | 90.9 | 90.0 | 89.6 | 1.30 | 0.27 |
| 4 | 118.9 | 119.7 | 119.2 | 118.9 | 1.32 | 0.63 |
| 5 | 147.6 | 148.5 | 148.1 | 148.1 | 1.02 | 0.57 |
| 6 | 174.4 | 175.1 | 174.6 | 174.6 | 1.12 | 0.65 |
| 7 | 199.2 | 199.7 | 198.8 | 198.7 | 1.40 | 0.50 |
| 8 | 221.5 | 221.8 | 220.9 | 220.7 | 1.42 | 0.37 |
| 9 | 243.7 | 244.1 | 243.0 | 242.6 | 1.94 | 0.29 |
| 10 | $265.0^{ab}$ | $265.1^{a}$ | $263.5^{ab}$ | $263.1^{b}$ | 1.98 | 0.08 |
| 11 | $285.2^{a}$ | $285.1^{a}$ | $283.3^{ab}$ | $282.8^{b}$ | 2.18 | 0.04 |
| 12 | $305.5^{a}$ | $305.2^{ab}$ | $303.3^{cb}$ | $302.8^{c}$ | 2.46 | 0.03 |

**Remark:** Different characters horizontally showed significant differences ($P<0.05$).

T1 : Treatment 1 100% commercial feed

T2 : Treatment 2 commercial feed: Napier grass: rice bran: 50%: 30%: 20%

T3 : Treatment 3 commercial feed: Napier grass: rice bran: 30%: 50%: 20%

T4 : Treatment 4 commercial feed: Napier grass: rice bran: 0%: 80%: 20%

### Increased length of Tilapia

At the end of the experiment, it found that T1 had the most significant average increase in the length of tilapia at 24.5 cm, followed by T3, T2, and T4, with an average length of tilapia at 23.9 cm, 23.5 cm, and 23.2 cm, respectively. When comparing, there was statistically significant difference in all experimental sets ($p<0.05$) (Table 2).

**Table 2** The average length of tilapia fed with different level of Napier for 12 weeks**.**

| Period (week) | average length of tilapia (cm) | | | | | |
|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | SEM | P-value |
| 0 | 7.1 | 7.2 | 7.2 | 7.2 | 0.04 | 0.82 |
| 1 | 8.3 | 8.3 | 8.0 | 8.1 | 0.06 | 0.20 |
| 2 | $9.4^{a}$ | $9.3^{a}$ | $8.9^{b}$ | $8.9^{b}$ | 0.04 | 0.01 |
| 3 | $10.6^{a}$ | $10.4^{ab}$ | $10.0^{bc}$ | $9.9^{c}$ | 0.08 | 0.01 |
| 4 | $11.8^{a}$ | $11.4^{b}$ | $11.9^{a}$ | $11.1^{b}$ | 0.08 | 0.00 |
| 5 | $13.3^{b}$ | $12.7^{c}$ | $13.8^{a}$ | $12.9^{c}$ | 0.10 | 0.00 |
| 6 | $16.2^{a}$ | $15.4^{b}$ | $16.5^{a}$ | $15.5^{b}$ | 0.12 | 0.00 |
| 7 | $19.1^{a}$ | $18.2^{b}$ | $19.2^{a}$ | $18.2^{b}$ | 0.14 | 0.00 |
| 8 | $21.1^{a}$ | $20.3^{b}$ | $21.2^{a}$ | $20.3^{b}$ | 0.16 | 0.00 |
| 9 | $22.0^{a}$ | $21.1^{b}$ | $21.9^{a}$ | $21.1^{b}$ | 0.26 | 0.02 |
| 10 | $22.8^{a}$ | $21.9^{bc}$ | $22.6^{ab}$ | $21.8^{c}$ | 0.30 | 0.03 |
| 11 | $23.7^{a}$ | $22.8^{b}$ | $23.3^{ab}$ | $22.6^{b}$ | 0.34 | 0.03 |
| 12 | $24.5^{a}$ | $23.5^{b}$ | $23.9^{ab}$ | $23.2^{b}$ | 0.28 | 0.01 |

**Remark:** Different characters horizontally showed significant differences (P<0.05).

T1 : Treatment 1 100% commercial feed

T2 : Treatment 2 commercial feed: Napier grass: rice bran: 50%: 30%: 20%

T3 : Treatment 3 commercial feed: Napier grass: rice bran: 30%: 50%: 20%

T4 : Treatment 4 commercial feed: Napier grass: rice bran: 0%: 80%: 20%

**Average survival rate of tilapia at the end of the experiment.**

The experimental results of using Napier Pak chong 1 grass in tilapia diet were found. T4 had the highest survival rate of 95.56%, followed by T3, T2, and T1, with survival rates of 94.44 %, 92.22 %, and 91.22 %, respectively. The statistical analysis of the results found that all treatments were statistically different (p<0.05) (Table 3).

**Feed costs**

At the end of the experiment, T4 had the lowest feed cost of 2.28 Bath/kg, followed by T3, T2, and T1, with feed costs of 7.05, 10.23, and 17.50 Bath/kg, respectively. Furthermore, from the statistical analysis of the results, it was found that all treatments were statistically different (Table 3).

From this experiment, considering the Tilapia average length of all feed formulas was not statistically different in the first 9 weeks. The weight gain was the highest in T1. The survival rate was the highest in T4, FCR was the best in T1, and feed cost was the best in T4. When all parameters were compared, it can be seen that T3 was ranked 2nd on all parameters except average length. Therefore, this experiment recommended using the T3 formula for Tilapia culture

**Table 3** Survival rate, feed conservation ratio (FCR) and feed costs of 4 experimental feed formulas over a period of 12 weeks.

| | T1 | T2 | T3 | T4 | SEM | P-value |
|---|---|---|---|---|---|---|
| Survival rate | 91.22$^{d}$ | 92.22$^{c}$ | 94.44$^{b}$ | 95.56$^{a}$ | 0.04 | 0.00 |
| FCR | 2.57$^{c}$ | 2.59$^{a}$ | 2.58$^{b}$ | 2.59$^{a}$ | 0 | 0.00 |
| Feed costs (Bath/kg) | 17.5$^{a}$ | 10.23$^{b}$ | 7.05$^{c}$ | 2.28$^{d}$ | 0 | 0.00 |

**Remark:** Different characters horizontally showed significant differences (P<0.05).

T1 : Treatment 1 100% commercial feed

T2 : Treatment 2 commercial feed: Napier grass: rice bran: 50%: 30%: 20%

T3 : Treatment 3 commercial feed: Napier grass: rice bran: 30%: 50%: 20%

T4 : Treatment 4 commercial feed: Napier grass: rice bran: 0%: 80%: 20%

At the end of the experiment, T4 had the lowest feed cost of using Napier grass for tilapia culture *(Oreochromis niloticus)* to compare each feed formula's efficiency in the tilapia culture analyzed. All treatments with Napier grass supplementation showed statistically significant difference ($p<0.05$) from the control with an 30% protein percentage level. Therefore, Napier grass supplementation of up to 50 % of the diet did not affect protein levels or the growth of tilapia. It is consistent with Bunyavirot et al. (1995); Thinnakorn (1994) and Nakhon Ratchasima Animal Feed Research and Development Center (2015) found that the Protein content of Napier grass was about 8-10%, 14.72%, and 15.07%, respectively, which was considered to be very close to the protein level in the control diet. The weight gain of tilapia was statistically significant difference between all treatments ($p<0.05$). It is consistent with Klahan et al. (2023); Cheng et al. (2016) and Shaha et al. (2015).

The cost of feed per kilogram of all treatments was significantly different. The treatment with the most significant proportion of Napier grass supplementation had the lowest cost. Consistent with Paothong et al. (2014) a study on the use of Napier grass strain-type Pakchong to replace commercial feed in fattened pigs found that pigs fed with Napier grass strain-type Pakchong replaced for commercial feed were up to 10 percent. Moreover, the feed cost per 1 kg of weight gain was lower than the group that ate only commercial feed at 8.98 baht per kg.

**Feed Convertion Ratio**

At the end of the experiment, it was found that T1 had the lowest FCR of 2.57, followed by T2, T3, and T4, with FCRs of 2.58, 2.59, and 2.59, respectively. The statistical analysis of the results found that all treatments were statistically different ($p<0.05$) (Table 3).

In the Feed Conversion Ratio (FCR), at the end of the experiment, there were statistically significant differences in all treatments. The control had the lowest FCR. Furthermore, when supplementing Napier grass, FCR was higher the ratio, the higher the FCR value, as the Napier grass

did not fully utilize the tilapia because this experiment used the trunk of the Napier grass, which is difficult for fish to digest. Consistent with the report of Samphet (1987) that mentions the digestibility of Napier grass, animals like to eat young grasses and leaves. However, when the grass grows older, animals choose to eat only the leaves. It is because the grasses with more leaves have much protein as well. The study by Thadsri, (1988) said that the digestibility in different parts of plants showed that the percentage of protein in the leaves was higher than in the stem.

## Conclusion

The study of tilapia culture was aimed at developing a Napier diet for tilapia and comparing each formula's efficacy in rearing tilapia was as follows: weight: Every formula which were significantly different ($p<0.05$). Feed conversion ratio which were significantly different ($p<0.05$). In terms of survival rate which were significantly different ($p<0.05$). It found that T4 had the lowest cost of 2.28 baht/kg, which were statistical significance ($p<0.05$). From the experimental results, Napier grass can be effectively used as feed for tilapia culture and reduce the cost of tilapia farming.

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