# Growth Performance and Haematological Evaluation in Female Rabbit Fed Diets Containing Dried Dates (*Phoenix* *dactylifera*) Fruits Meal

**ABSTRACT**

*This study was carried out to assess the effect of dried dates fruits meal (DDFM) as supplement in the diets on the growth performance and haematological profile in female rabbits . Thirty-six female rabbits (does) were used for the study. The rabbit does were randomly allotted to four experimental groups in a completely randomized design which had nine does in each treatment and further replicated three times to have 3 rabbit does in each replicate. The four experimental diets containing dried dates fruits meal at 0.00, 0.50, 1.00 and 1.50% respectively, were tagged T1, T2. T3, and T4 respectively. The study lasted for 168 days (24 weeks). The growth parameters that were assessed in the study were initial weight, final weight, total and daily weight gain, total and daily feed intake, and feed conversion ratio. Blood samples were collected at the end of the study from each replicate for haematological analysis to evaluated packed cell volume (PCV), red blood cells (RBC), white blood cells (WBC), hemoglobin (HB), mean corpuscular hemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV), Neutrophils, monocytes, eosinophils, basophils and lymphocytes. The results revealed that there were significant differences (P=.05) in final weight, total weight gain, daily weight gain, and feed conversion ratio across the treatments. The results revealed significant effects (P=.05) of DDFM on Packed Cell Volume (PCV), Platelet count, and Haemoglobin (Hb) concentration. For PCV, the highest value was recorded in T3 (36.67%), which was significantly higher than the values observed in T1 (30.33%) and T2 (30.67%), indicating that increased levels of DDFM improved the PCV. Conclusion, DDFM supplementation in rabbit does diets at 1.00% can improve growth traits and haematological indices, leading to better overall health status in the female does.*

# Keywords: Dates fruits, performance, haematology, female rabbits, performance

# INTRODUCTION

# Rabbits produce a nutritious white meat that is high in protein and low in fat and cholesterol, as well richer in proteins, certain vitamins and minerals than chicken, turkey, beef, or pork (Flanders, 2012). . According to Hassan *et al.* (2012), the rabbit's fast growth rate, high prolificacy, high genetic selection potential, high feed conversion efficiency and economic utilization of space make them suitable for increased animal protein production. Taiwo *et al.* (2004), further added that the rabbit's high fecundity, low cost of investment, short generation interval, as well as ability to utilize diverse forages as advantages for increased production.

# Date fruits contain a very high nutritional value because of its components. The fruit contains a lot of carbohydrates, vitamins, and minerals (Ardekani *et al.,* 2010). Some of the benefits of the date fruit have been studied as an anti-inflammatory, anti-diabetic, nephroprotective, hepato-protective anti-oxidants and fertility (Hafez and El-Sohaimy, 2010). Al-Shwyeh (2019) also reported date fruits as a rich source of phenolic antioxidants with antibacterial and anti-inflammatory activity. Since, nutrition affects blood parameters, this study, was therefore, designed to investigate the effect of dried dates fruits meal on the growth performance and haematological characteristics in female rabbits.

# 2. MATERIALS AND METHODS

**2.1 Experimental Site**

The research was carried out at the Rabbitry Unit of the Teaching and Research Farm, Department of Animal Science, University of Uyo, Akwa Ibom State. Uyo is situated at a latitude of 4º 591 to 5º 041 N and a longitude of 7º 531 to 8º 001 E, with an elevation of approximately 60.96 meters above sea level. The region exhibits a bimodal rainfall pattern with an average annual rainfall of 2190 millimeters and a mean relative humidity of 81% (Solomon *et al.,* 2024).

**2.2 Sourcing and Processing of Test Materials**

Dried date palm fruits were procured from a local market in Itu Local Government Area, Akwa Ibom State. The fruits were subjected to air drying and subsequently milled using an electric grinding machine to obtain dried date palm fruit meal (DDFM).

# 2.3 Proximate analysis of dried date palm fruits meal and experimental diets

Dried date palm fruits meal (DDFM) and the four experimental diets were analyzed according to the method of AOAC (2010) to determine the dry matter, crude protein, crude fibre, ether extract, ash and nitrogen free extract (NFE) contents.

**2.4 Experimental Animals and Management**

Thirty-six female growing rabbits aged between eight and ten weeks were utilized for the study. A two-week acclimatization period was implemented, during which the rabbits received a formulated ration. Subsequently, the rabbits were randomly assigned to four treatment groups, each receiving a diet containing varying levels of DDFM: 0.00% (control), 0.00%, 0.50%, 1.00 and 1.50%, respectively. Prior to the commencement of the experiment, prophylactic measures were taken to address internal and external parasites through subcutaneous administration of ivermectin injection (0.1 ml/rabbit). Additionally, a broad-spectrum antibiotic, Oxytetracycline L.A (0.2 ml/rabbit), was administered to minimize bacterial load. The rabbits were managed under intensive conditions and housed in wired wooden rabbit hutches within an open-ended rabbit house to ensure adequate ventilation. Throughout the 168-day (24-week) experimental period, the rabbits were provided with feed, water, and forages ad libitum. Weekly weights were taken to monitor growth progress.

**2.5 Ethical Statement**

All authors hereby declare that “Principles of laboratory animal care” (NIH Publication No. 85-23, revised 1985) were followed as well as specific national laws were applicable. All experiments have been examined and approved by the Ethics committee of Animal Science Department, University of Uyo, Nigeria.

# 2.6 Experimental Diets

Four experimental diets were formulated to contain varying levels of DDFM: 0.00% (control), 0.50%, 1.00%, and 1.50%, designated as T1, T2, T3, and T4, respectively. The control diet (T1) served as a baseline, containing no DDFM. All diets were fotified with bone meal, vitamin premix, and salt.

 **Table 1: Composition of Experimental Diet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ingredients  | T1(0.00% DDFM) | T2(0.50% DDFM) | T3(1.00% DDFM) | T4(1.50% DDFM) |
| Maize | 45.00 | 45.00 | 45.00 | 45.00 |
| Soybean cake  | 21.00 | 21.00 | 21.00 | 21.00 |
| Wheat Offal  | 17.10 | 17.10 | 17.10 | 17.10 |
| Rice offal | 5.00 | 5:00 | 5:00 | 5:00 |
| Palm Kernel Cake | 8.00 | 8.00 | 8.00 | 8.00 |
| Bone meal | 3.00 | 3.00 | 3.00 | 3.00 |
| Common salt | 0.25 | 0.25 | 0.25 | 0.25 |
| Vit-Premix | 0.25 | 0.25 | 0.25 | 0.25 |
| Lysine  | 0.20 | 0.25 | 0.25 | 0.25 |
| Methionine  | 0.20 | 0.25 | 0.25 | 0.25 |
| TOTAL | 100.00 | 100.00 | 100.00 | 100.00 |
| Calculated Composition |  |  |  |
| Metabolizable Energy (Kcal/Kg) | 2806.30 | 2806.30 | 2806.30 | 2806.30 |
| Crude Protein (%) | 17.15 | 17.15 | 17.15 | 17.15 |
| Crude fibre (%) | 5.56 | 5.56 | 5.56 | 5.56 |
| Ether Extract (%) | 6.87 | 6.87 | 6.87 | 6.87 |

**2.7 Experimental Design**

A completely randomized design (CRD) was employed to allocate the four treatment groups to the respective experimental diets. Each treatment group consisted of three replicates, with each replicate comprising three rabbits. This resulted in a total of nine rabbits per treatment. The experimental feeding period for each replicate was twenty-four weeks (168 – days).

 The statistical model adopted was:

Yіј = μ+Tі +eіј

Where:

Yіј = single observation μ = overall mean

Tі = Treatment effect

eіј = Random error associated with the jth observation in the

 ith treatment

# 2.8 Data Collection

**2.8.1 Measurement of Live Weight Change**

Live weight was measured for each doe in each group using electronic weighing scale with a sensitivity of 1g weekly during the feeding period and changes in weights were recorded and presented in a table.

**Feed intake:** Feed intake was evaluated by subtracting the leftover from the quantity of feed offered the previous day in a 24 hours’ cycle.

**Total weight gain:** Total weight gain was calculated as the difference between final weight and initial weight.

Total weight gain (g) = final weight – Initial weight.

**Daily weight** **gain** was obtained by dividing the total weight gain by 168 days as follows:

Daily weight gain (g) = $\frac{Total weight gain }{168 days}$

**Total feed intake**: Total feed intake was calculated by summing the total feed consumed by the animals for 168 days of the experiment.

**Daily feed intake**: This was computed by dividing the total feed consumed by the animals of females during the experiment by 168 days as follows:

Daily feed intake (g) = $\frac{Total Feed Intake }{168 days}$

**Feed conversion ratio (FCR)**: Feed conversion ratio was computed by dividing the total feed intake by total weight gain during the study as follows:

Feed Conversion Ratio = $\frac{Total feed intake}{Total weight gain}$

**2.8.2 Haematological Parameters**

At the conclusion of the 24-week experimental period, blood samples were collected from one randomly selected doe within each replicate. Blood collection was performed via the external ear vein between 7:00 and 8:30 AM using a sterile disposable syringe and needle. Prior to collection, sterile universal bottles containing Ethylenediaminetetraacetic acid (EDTA) as an anticoagulant were labeled for sample identification. Following blood collection, the puncture site was disinfected with a cotton swab soaked in methylated spirit to prevent infection.

The following hematological parameters were assessed: packed cell volume (PCV), red blood cells (RBC), white blood cells (WBC), hemoglobin (Hb), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), neutrophils, and lymphocytes. Blood samples were subjected to laboratory analysis using an automated analyzer, and the results were tabulated.

# 2.9 Statistical Analysis

# The experimental data were subjected to analysis of variance (ANOVA) procedure in a completely randomized design, using IBM Statistical Package for Social Science (SPSS) version 21. Differences between treatment means were separated using Duncan multiple Range Test of the software.

**3. RESULTS**

**3.1 Growth Performance of Rabbit Does Fed Diets Containing Dietary Levels of Dried Date Fruits Meal**

The growth performance of rabbit does fed diets containing varying levels of dried date fruits meal (DDFM) is presented in Table 2. The results revealed significant differences *(P=.05)* in final weight, total weight gain, daily weight gain, and feed conversion ratio across the treatments. The highest final weight was observed in T3 (1887.39 g), which was significantly greater than the final weight in T1 (1629.39 g), T2 (1741.00 g), and T4 (1847.33 g). Similarly, total weight gain was significantly higher in T3 (1138.28 g), followed by T4 (1099.11 g), T2 (993.78 g), and the lowest in T1 (886.39 g). Daily weight gain followed a similar trend, with T3 showing the highest daily weight gain (8.13 g), followed by T4 (7.85 g), T2 (7.10 g), and T1 (6.33 g), respectively.

No significant differences were observed in feed intake and daily feed intake across all treatments, with values of 13392.90 g, 13548.00 g, 13530.67 g, and 13530.67 g for T1, T2, T3, and T4, respectively, and daily feed intake values ranging from 95.66 g to 96.86 g. Feed conversion ratio (FCR) was significantly better (lower) in T4 (12.85), followed by T3 (13.01), T2 (14.30), and T1 (18.30), indicating that rabbit does fed diets with higher levels of dried date fruits meal had more efficient feed utilization.

**Table 2: Growth performance of rabbit does fed diets containing dietary levels of dried date friuts meal**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters | T1 | T2 | T3 | T4 | SEM |
| Initial weight (g) | 743.00 | 747.22 | 749.11 | 748.22 | 81.24 |
| Final weight (g) | 1629.39b | 1741.00ab | 1887.39a | 1847.33a | 51.90 |
| Total weight gain (g) | 886.39b | 993.78ab | 1138.28a | 1099.11a | 94.71 |
| Daily weight gain (g) | 6.33b | 7.10ab | 8.133a | 7.85a | 7.35 |
| Feed intake (g) | 13392.90 | 13548.00 | 13530.67 | 13530.67 | 48.02 |
| Daily feed intake (g) | 95.66 | 96.77 | 96.86 | 96.65 | 0.34 |
| Feed Conversion Ratio | 18.30a | 14.30b | 13.01b | 12.85b | 1.53 |

SEM – Standard error of mean, means without letters were not significant (p>0.05)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Total weight gain (g) | 886.39 | 993.78 | 1138.28 | 1099.11 |
| Daily weight gain (g) | 5.276130952 | 5.915357143 | 6.77547619 | 6.542321429 |
| Daily feed intake (g) | 79.71964286 | 80.64285714 | 80.53970238 | 80.53970238 |
| Feed Conversion Ratio | 15.10948905 | 13.63279599 | 11.88694346 | 12.31056946 |

**3.2 Haematological Indices of Rabbit Does Fed Diets Containing Dried Date Fruits Meal**

The haematological indices of rabbit does fed diets containing varying levels of dried date fruits meal (DDFM) are presented in Table 3. The results revealed significant effects *(P=.05)* of DDFM on Packed Cell Volume (PCV), Platelet count, and Haemoglobin (Hb) concentration. For PCV, the highest value was recorded in T3 (36.67%), which was significantly higher than the values observed in T1 (30.33%) and T2 (30.67%), indicating that increasing levels of DDFM improved the PCV. The PCV value in T4 was 36.33%, which was similar to T3 but significantly higher than both T1 and T2. Platelet counts were significantly higher in T3 (197.67) compared to T1 (123.33), with T2 (154.00) and T4 (139.67) having intermediate values. Haemoglobin concentration was significantly higher in T4 (11.70 g/dL) compared to T1 (9.33 g/dL), with T2 (10.13 g/dL) and T3 (11.57 g/dL) showing intermediate values.

In contrast, no significant differences (p>0.05) were observed in the White Blood Cell (WBC) count, Red Blood Cell (RBC) count, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), and Mean Corpuscular Haemoglobin Concentration (MCHC) across the treatments. The WBC count ranged from 4.80 × 10⁹/dL in T4 to 5.67 × 10⁹/dL in T2, with T1 (5.27 × 10⁹/dL) and T3 (5.47 × 10⁹/dL) showing intermediate values. The similarity in WBC counts across the groups indicates that the DDFM supplementation did not significantly affect the WBCs. The RBC counts were 4.37 × 10¹²/L in T1, 4.33 × 10¹²/L in T2, 4.90 × 10¹²/L in T3, and 5.17 × 10¹²/L in T4. While there was a trend towards higher RBC counts in T3 and T4, the differences were not significant. Similarly, MCV values were 69.33 fl in T1, 71.00 fl in T2, 75.67 fl in T3, and 69.67 fl in T4, showing no significant effect of DDFM on the average volume of red blood cells. MCH values, which reflect the amount of haemoglobin per red blood cell, were 21.33 pg in T1, 23.33 pg in T2, 23.67 pg in T3, and 22.67 pg in T4. The MCHC values, which indicate the concentration of haemoglobin in a given volume of packed red blood cells, were 31.33% in T1, 33.33% in T2, 31.33% in T3, and 33.00% in T4, with no significant differences observed across the treatments. These parameters suggest that the DDFM supplementation did not significantly alter the general characteristics of red blood cells or their haemoglobin content.

**Table 3: Haematological indices of rabbit does fed diets containing dietary levels of dried date friuts meal**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters | T1 | T2 | T3 | T4 | SEM |
| Packed Cell Volume (%) | 30.33b | 30.67b | 36.67a | 36.33a | 1.01 |
| White Blood Cells (×109/dL) | 5.27 | 5.67 | 5.47 | 4.80 | 0.39 |
| Platelet | 123.33c | 154.00b | 197.67a | 139.67bc | 21.91 |
| Red Blood Cells (×1012/L) | 4.37 | 4.33 | 4.90 | 5.17 | 0.14 |
| MCV (fl) | 69.33 | 71.00 | 75.67 | 69.67 | 1.21 |
| MCH (pg) | 21.333 | 23.33 | 23.67 | 22.67 | 0.52 |
| MCHC (%) | 31.33 | 33.33 | 31.33 | 33.00 | 0.64 |
| Haemoglobin (g/dL) | 9.33b | 10.13ab | 11.57a | 11.70a | 10.68 |
| Lymphocytes (%) | 60.00 | 70.00 | 62.33 | 63.33 | 1.80 |
| Eosinophil (%) | 4.67 | 4.67 | 4.00 | 4.00 | 0.19 |
| Monocytes (%) | 3.67 | 3.00 | 3.00 | 2.67 | 0.19 |
| Neutrophils (%) | 31.33 | 22.00 | 30.33 | 29.67 | 1.71 |
| Basophil (%) | 0.33 | 0.33 | 0.33 | 0.33 | 0.14 |

MCV - mean corpuscular volume, MCH – mean corpuscular haemoglobin, MCHC – Mean corpuscular haemoglobin concentration, SEM – Standard error of means; Means with different superscripts are significant *(P=.05)*

For the differential white blood cell counts, there was no significant difference (p>0.05) in the percentage of Monocytes, with T1 (3.67%) showing a non-significantly higher percentage compared to the other treatments, T2 (3.00%), T3 (3.00%), and T4 (2.67%) diets respectively, which had lower monocyte percentages. Also, non-significant differences were observed in the percentages of Lymphocytes, Eosinophils, Neutrophils, and Basophils. The percentage of Lymphocytes ranged from 60.00% in T1 to 70.00% in T2, with T3 and T4 showing 62.33% and 63.33%, respectively. Eosinophil percentages were 4.67% in T1 and T2, and 4.00% in T3 and T4, indicating that the DDFM had little effect on this parameter in the does. Neutrophil percentages ranged from 22.00% in T2 to 31.33% in T1, with T3 (30.33%) and T4 (29.67%). Basophil percentages remained consistent across all treatments at 0.33%.

Overall, while significant differences were observed in PCV, Platelet count, and Haemoglobin concentration, the majority of haematological indices, including WBC count, RBC count, MCV, MCH, MCHC, and differential white blood cell counts, showed no significant differences across the treatments. This indicates that the addition of dried date fruits meal influenced specific aspects of the rabbits' blood profile, particularly related to red blood cell function, platelet production, and haemoglobin concentration, but did not significantly affect other haematological parameters.

**4. DISCUSSION**

**4.1 Growth performance of rabbit does fed diets containing varying levels of dried date fruits meal**

The growth performance of rabbit does fed diets containing varying levels of dried date fruits meal (DDFM) revealed significant improvements in the final weight, total weight gain, daily weight gain, and feed conversion ratio (FCR), aligning with findings in existing literature on the effects of plant-based feed additives. The significantly higher final weights recorded in T3 (1887.39 g) and T4 (1847.33 g) compared to T1 (1629.39 g) are consistent with the observations of Reece *et al.* (2015), and Malik *et al.* (2022), who reported improved body weight in animals supplemented with nutrient-rich plant-based feeds. DDFM, which contains a high nitrogen-free extract (78.81%) and minerals such as calcium and iron, likely enhanced energy availability and skeletal development, as noted by Etim *et al.* (2014), who emphasized the role of dietary minerals in growth performance.

The total weight gain and daily weight gain observed In T3 and T4 were significantly higher than T1, suggesting that DDFM improved nutrient assimilation and feed utilization. This finding supports the report of Omoikhoje *et al.* (2024), who noted increased weight gain in animals fed diets supplemented with Jatropha leaf meal. Similarly, Essien *et al.* (2023) attributed improved growth to the phytochemical and energy composition of plant-based supplements, which enhance protein synthesis and metabolic activity.

Feed intake and daily feed intake did not vary significantly across treatments, with values ranging from 13392.90 g to 13548.00 g and 95.66 g to 96.86 g, respectively. This stability aligns with the findings of Malik *et al.* (2022), who reported no significant differences in feed intake among broilers fed plant-based diets. This suggests that DDFM does not influence feed palatability or consumption but enhances growth by improving nutrient efficiency, as evidenced by the significantly better FCR in T4 (12.85) and T3 (13.01) compared to T1 (18.30). The improved FCR observed in this study indicates more efficient feed utilization with higher DDFM inclusion. This is consistent with the findings of Ameer *et al.* (2022), who reported enhanced FCR in rabbits fed diets containing bioactive-rich plant extracts. DDFM’s rich phytochemical composition, including flavonoids and saponins, may have contributed to better nutrient absorption and gut health, as reported by Soetan *et al.* (2013).

**4.2 Haematological indices of rabbit does fed diets containing dietary levels of dried date fruits meal**

Hematological indices according to Okorie *et al.* (2011), offer a means of conducting clinical investigations on the existence of various metabolites and other components in an animal, and can also be used as crucial tool for determining the health status of an individual as well as in the diagnosis of various pathological and metabolic problems (Afolabi *et al.,* 2011). The haematological findings in this study align with established literature, showcasing the potential of dried date fruits meal (DDFM) in improving certain blood parameters while maintaining overall blood health. The packed cell volume (PCV), an important marker of oxygen-carrying capacity, was significantly elevated in T3 and T4, consistent with the reports of Reece *et al.* (2015) and the Merck Veterinary Manual (2012), which identify PCV values of 30–50% as optimal for healthy rabbits. This suggests that DDFM supplementation supports efficient oxygen transport, critical for growth and metabolism.

White blood cell (WBC) counts showed no significant differences across treatments, maintaining values within the normal range (6.00–12.00 × 10⁹/dL) recommended by Merck Veterinary Manual (2012). This indicates that DDFM did not compromise the rabbits’ immunity. Similar findings were reported by Istifanus *et al.* (2022), who highlighted the importance of WBC in combating infections and maintaining immunity. Moreover, Soetan *et al.* (2013), emphasized that WBC plays a crucial role in antibody production and phagocytosis, and the current findings confirm that DDFM supplementation supports these immune functions without negative impacts. The WBC aids to protect the body from pathogen (Odunitan-Wayas *et al.,* 2018). White blood cell (WBC) counts typically increase in response to pathogens, enhancing the body’s defense mechanisms (Onyema *et al.,* 2024), implying that the rabbit does were not exposed to pathogenic infections nor were their immune system compromised. The WBC differentials, including granulocytes (neutrophils, basophils, eosinophils) and non-granulocytes (lymphocytes, monocytes), provide specific insights into immune system activity (Onyema *et al.,* 2024). Lymphocytes, according to Afolabi *et al.* (2011), are the most common form of white blood cell, followed by heterophils, eosinophils, and monocytes. Since lymphocytes are reactive cells in inflammation and delayed hypersensitivity, they are involved in the manufacture of antibodies (Banks, 2014).

Red blood cell (RBC) counts, haemoglobin (Hb) levels, and other red cell indices (MCV, MCH, and MCHC) remained unaffected, with values falling within the normal reference ranges for healthy rabbits (Merck Veterinary Manual, 2012). This aligns with observations by Ameer *et al.* (2022) and Istifanus *et al.* (2022), who noted that stable RBC parameters reflect the absence of anemia and the adequate oxygen-carrying capacity of the blood. The function of RBC as noted by (Onyema *et al.* (2024), is to transport oxygen from the lungs to tissues and remove carbon dioxide from the tissues to the lung in the body via haemoglobin. The unaffected RBC and Hb levels suggest that DDFM supplementation does not impair erythropoiesis, further affirming its safety and suitability in rabbit diets. The MCV is used to calculate the average erythrocyte size, the MCH to measure haemoglobin amount per blood cell and the MCHC to know the amount of haemoglobin relative to the size of the cell per red blood cell (Odunitan-Wayas *et al.,* 2018). Results on MCV, and MCH in the current study indicated a lack of macrocytic or hypochromic anemia in rabbit does as supported by Onyema *et al.* (2024).

The study also recorded significant Increases in platelet counts, particularly in T3 and T4. Elevated platelets suggest enhanced blood clotting potential, which is vital for preventing excessive blood loss during injuries. This observation aligns with Etim *et al.* (2014), who noted that higher platelet counts enhance clot formation, ensuring rapid wound healing.

**5. CONCLUSION**

The findings of this study, indicated that DDFM at 1.00% can be supplemented in female rabbits’ diets to improve growth parameters without exhibiting any deleterious effect on the animals’ health.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Authors hereby declare that NO generative AI technologies such as Large Lnaguage Models (ChatGPT, COPILOT, etc) and text – to – image generators have been used during the writing or editing of this manuscript.

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