

## ORIGINAL ARTICLE

# Effect of Feeding Pulse Chunni based Complete Diets on Growth in Nellore Brown Ram Lambs

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## ABSTRACT

**Background:** Feed resources are the major constraint in livestock production, as conventional feed ingredients compete with human food demands. Agro-industrial by-products such as pulse chunnies serve as promising alternative feed resources. Incorporating these by-products in complete diets based on sorghum straw may help improve nutrient utilization, growth, and cost efficiency in sheep rearing.

**Aim:** To evaluate the effect of inclusion of different pulse chunnies in sorghum-straw-based complete diets on growth performance of Nellore brown ram lambs.

**Objectives:**

1. To assess the feed intake and nutrient utilization in lambs fed diets containing different pulse chunnies.
2. To evaluate the effect of pulse chunni inclusion on growth rate and body weight gain.
3. To determine the economic efficiency of meat production through pulse chunni-based complete diets.
4. To examine any adverse health effects of pulse chunni inclusion in lamb diets.

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**Materials:**

- **Animals:** Thirty-two Nellore brown ram lambs ( $96.30 \pm 2.70$  days;  $13.27 \pm 0.03$  kg body weight).
- **Experimental design:** Random allocation to four treatment groups (8 lambs each) and reared under an intensive system for 120 days.
  - T1: Control diet (no pulse chunni)
  - T2: 15% Red gram chunni (RGCC)
  - T3: 15% Green gram chunni (GGCC)
  - T4: 15% Bengal gram chunni (BGCC)
- **Parameters studied:** Feed intake, daily dry matter intake (DMI), body weight changes, total weight gain, average daily gain (ADG), and health status.

**Results:**

- Total feed intake and daily DMI were significantly higher ( $P < 0.01$ ) in T2 compared to other groups.
- Body weight differed significantly among groups from the 2nd to 8th fortnights, with T2 recording the highest values.
- Total body weight gain (kg): T1 - 10.65, T2 - 10.98, T3 - 10.76, T4 - 10.66.
- Average daily gain (g/day): T2 ( $91.46 \pm 0.49$ ) was significantly higher than T1 ( $88.75 \pm 0.90$ ), T3 ( $89.69 \pm 0.49$ ), and T4 ( $88.85 \pm 0.49$ ).
- No adverse health effects were observed across treatments.

**Conclusion:** Inclusion of red gram chunni at 15% level in sorghum-straw-based complete diet improved feed intake, nutrient availability, and growth rate in Nellore ram lambs, thereby reducing the cost of meat production. Other pulse chunnies also supported normal growth without adverse health effects, but red gram chunni proved to be the most effective option.

**KEYWORDS**

• Pulse Chunnies • Complete Diets • Nellore Brown Ram Lambs • Dry Matter Intake • Average Daily Gain • Feed Conversion Ratio

**INTRODUCTION****Background**

Livestock production is heavily influenced by feed resources, with feed costs accounting for nearly three-fourths of the total production expenditure. In India, the availability of quality feed and fodder is steadily declining, while traditional reliance on cereals and legumes for animal feeding creates competition with human consumption. The growing food processing sector has, however, generated a large quantity of agro-industrial by-products, such as pulse chunnies, which remain underutilized. Pulse chunni, comprising broken grains, husk, and germ coat, constitutes 15–20% of total pulse weight and has been shown to support nutrient utilization and livestock performance when included in ruminant diets. In Telangana, despite the availability of over 4 lakh tonnes of brans and chunnies annually, their use in

animal nutrition remains inefficient. Given the poor nutritive value of crop residues like sorghum stover, strategic incorporation of pulse chunnies into complete diets could reduce feeding costs, improve nutrient utilization, and enhance animal productivity. However, information on their chemical composition, nutritive potential, and optimal inclusion levels in livestock diets is limited.

**AIM AND OBJECTIVES****Aim**

To evaluate the nutritive potential and feeding value of pulse chunnies in sorghum-stover-based complete rations for ruminants.

**Objectives**

1. To determine the chemical composition and nutritive profile of different pulse chunnies.

2. To formulate complete rations by incorporating pulse chunnies at different levels with sorghum stover.
3. To assess the effect of pulse chunni inclusion on feed intake, nutrient digestibility, and growth performance of ruminants.
4. To evaluate the cost-effectiveness of feeding pulse chunnies compared to conventional feeds.

## Hypothesis

Inclusion of pulse chunnies in sorghum-stover-based complete rations improves nutrient utilization, growth performance, and feed cost efficiency in ruminants compared to conventional diets without chunnies.

## MATERIAL AND METHOD

### Location and Duration of the Study

The experiment was conducted at the Livestock Research Station, PVNRTVU, Mamnoor, Warangal district, situated at an altitude of 290 m above mean sea level on 17.9°N latitude and 79.59°E longitude. During the study period, the average maximum and minimum temperatures were 35.5°C and 25.6°C, respectively. The growth trial was carried out for 120 days.

### Preparation of Experimental Complete Rations

**Procurement of feed ingredients:** Sorghum straw and concentrate ingredients

were procured from the local market, Hyderabad, while molasses was obtained from the Department of Animal Nutrition, College of Veterinary Science, PVNRTVU, Rajendranagar.

**Chopping:** Sorghum straw was chopped to a length of 1.5–2.0 cm using a chaff-cutter and used for complete ration formulation with a roughage-to-concentrate ratio of 50:50.

**Experimental rations:** Four sorghum-straw based complete diets were formulated Table 1:

- **T1:** Mash diet without chunni (control)
- **T2:** Mash diet with red gram chunni (15% of concentrate mixture)
- **T3:** Mash diet with green gram chunni (15% of concentrate mixture)
- **T4:** Mash diet with bengal gram chunni (15% of concentrate mixture)

**Processing:** Diets were prepared in 100 kg batches at the feed processing mill of Livestock Research Station, Mamnoor. Sorghum straw and concentrate ingredients were ground in a hammer mill (8 mm sieve) and conveyed to a horizontal mixer. Mineral mixture and vitamin supplements were premixed with ground bran and added in required quantities. Molasses was preheated to 70°C and added during mixing. Each batch was mixed for 10 minutes, processed into mash, and packed in gunny bags for feeding. Chemical composition of experimental diets presented in Table 2.

**Table 1:** Ingredient composition of experimental rations (kg/100 kg) used for growth study in Nellore ram lambs

| Ingredients        | Complete diets                         |                                       |                                         |                                          |
|--------------------|----------------------------------------|---------------------------------------|-----------------------------------------|------------------------------------------|
|                    | T1<br>(without any chunni:<br>Control) | T2<br>(with Red gram chunni:<br>RGCC) | T3<br>(with Green gram<br>chunni: GGCC) | T4<br>(with Bengal gram<br>chunni: BGCC) |
| Sorghum straw      | 50.0                                   | 50.0                                  | 50.0                                    | 50.0                                     |
| Red gram chunni    | -                                      | 7.5                                   | -                                       | -                                        |
| Green gram chunni  | -                                      | -                                     | 7.5                                     | -                                        |
| Bengal gram chunni | -                                      | -                                     | -                                       | 7.5                                      |
| Maize              | 13.0                                   | 14.0                                  | 15.0                                    | 13.0                                     |
| Ground nut cake    | 21.5                                   | 20.5                                  | 19.5                                    | 21.5                                     |
| Wheat bran         | 7.5                                    | -                                     | -                                       | -                                        |
| Molasses           | 5.0                                    | 5.0                                   | 5.0                                     | 5.0                                      |
| Mineral mixture    | 2.0                                    | 2.0                                   | 2.0                                     | 2.0                                      |
| Salt               | 1.0                                    | 1.0                                   | 1.0                                     | 1.0                                      |
| <b>Total*</b>      | <b>100.0</b>                           | <b>100.0</b>                          | <b>100.0</b>                            | <b>100.0</b>                             |

\*Vitamin A supplement was added @ 10g/100kg complete diet.

**Table 2:** Chemical composition of experimental complete diets (on % DMB) fed to growing Nellore ram lambs

| Nutrient                      | Complete diets*                        |                                       |                                         |                                          |
|-------------------------------|----------------------------------------|---------------------------------------|-----------------------------------------|------------------------------------------|
|                               | T1<br>(without any chunni:<br>Control) | T2<br>(with Red gram<br>chunni: RGCC) | T3<br>(with Green gram<br>chunni: GGCC) | T4<br>(with Bengal gram<br>chunni: BGCC) |
| <i>Proximate constituents</i> |                                        |                                       |                                         |                                          |
| Moisture                      | 1.71                                   | 3.34                                  | 2.39                                    | 3.16                                     |
| Dry matter                    | 98.29                                  | 96.66                                 | 97.61                                   | 96.84                                    |
| Organic matter                | 87.88                                  | 88.11                                 | 88.08                                   | 89.17                                    |
| Crude protein                 | 13.79                                  | 13.68                                 | 13.88                                   | 13.78                                    |
| Ether extract                 | 2.98                                   | 3.24                                  | 3.19                                    | 2.95                                     |
| Crude fibre                   | 22.86                                  | 20.56                                 | 21.03                                   | 25.02                                    |
| Nitrogen free extract         | 48.94                                  | 48.63                                 | 49.99                                   | 47.04                                    |
| Total ash                     | 12.12                                  | 11.89                                 | 11.92                                   | 10.83                                    |
| Calcium                       | 1.57                                   | 1.61                                  | 1.13                                    | 1.15                                     |
| Phosphorus                    | 0.83                                   | 0.66                                  | 0.70                                    | 0.80                                     |
| <i>Cell wall constituents</i> |                                        |                                       |                                         |                                          |
| Neutral detergent fibre       | 63.86                                  | 60.11                                 | 60.85                                   | 62.55                                    |
| Acid detergent fibre          | 33.82                                  | 34.12                                 | 33.15                                   | 35.95                                    |
| Cellulose                     | 25.43                                  | 23.95                                 | 23.27                                   | 26.86                                    |
| Acid detergent lignin         | 6.25                                   | 7.33                                  | 5.85                                    | 4.83                                     |
| Silica                        | 2.70                                   | 2.93                                  | 2.99                                    | 3.71                                     |
| Hemi cellulose                | 30.04                                  | 25.99                                 | 27.71                                   | 26.60                                    |

\*Each value is an average of duplicate analysis

### Selection and Distribution of Experimental Animals

Thirty-two growing Nellore brown ram lambs ( $96.3 \pm 2.7$  days of age;  $13.27 \pm 0.03$  kg BW) were selected from the Sheep Unit, Livestock Research Station, Mamnoon, for a 120-day

growth trial. The lambs were randomly allotted into four treatment groups (T1-T4), with eight animals per group, following a completely randomized design (CRD). Details of animal distribution among treatment groups are presented in Table 3.

**Table 3:** Distribution pattern of experimental animals for growth study

| Complete diets                         |                  |                                       |                  |                                         |                  |                                          |                  |
|----------------------------------------|------------------|---------------------------------------|------------------|-----------------------------------------|------------------|------------------------------------------|------------------|
| T1<br>(without any chunni:<br>Control) |                  | T2<br>(with Red gram chunni:<br>RGCC) |                  | T3<br>(with Green gram chunni:<br>GGCC) |                  | T4<br>(with Bengal gram chunni:<br>BGCC) |                  |
| Animal No.                             | Body Wt.<br>(Kg) | Animal No.                            | Body Wt.<br>(Kg) | Animal No.                              | Body Wt.<br>(Kg) | Animal No.                               | Body Wt.<br>(Kg) |
| 2638                                   | 13.20            | 2622                                  | 13.40            | 2626                                    | 13.30            | 2624                                     | 13.20            |
| 2612                                   | 13.50            | 2628                                  | 13.40            | 2616                                    | 13.20            | 2634                                     | 13.40            |
| 2646                                   | 12.80            | 2630                                  | 13.20            | 2632                                    | 13.20            | 2664                                     | 13.20            |
| 2678                                   | 13.20            | 2642                                  | 12.90            | 2658                                    | 13.20            | 2656                                     | 13.20            |
| 2688                                   | 13.50            | 2636                                  | 13.50            | 2604                                    | 13.20            | 92                                       | 13.40            |
| 2552                                   | 13.50            | 2674                                  | 13.30            | 2608                                    | 13.20            | 2650                                     | 13.30            |
| 96                                     | 13.20            | 2672                                  | 13.20            | 2654                                    | 13.20            | 94                                       | 13.40            |
| 2666                                   | 13.20            | 2648                                  | 13.40            | 2668                                    | 13.30            | 2684                                     | 13.10            |
| <b>Mean</b>                            | <b>13.26</b>     |                                       | <b>13.28</b>     |                                         | <b>13.22</b>     |                                          | <b>13.27</b>     |
| <b>± SE</b>                            | <b>± 0.08</b>    |                                       | <b>± 0.06</b>    |                                         | <b>± 0.01</b>    |                                          | <b>± 0.04</b>    |

## Housing and Management

The experimental lambs were housed under hygienic conditions in well-ventilated pens (24' × 10') with an adjacent open yard of equal size for day-time movement. Animals were maintained under a no-grazing system. All lambs were dewormed at the start of the trial and again after 60 days using Fenbendazole (for internal parasites). They were vaccinated against Peste des Petits Ruminants (PPR) disease 7 days after the first deworming. Proper sanitation and biosecurity were maintained throughout the trial. Each lamb was ear-tagged for individual identification and record keeping.

## Feeding and Watering

The four experimental rations (T1: control, T2: RGCC, T3: GGCC, T4: BGCC) were

randomly assigned to the four groups and offered ad libitum twice daily at 9:00 am and 3:00 pm. Feed was offered in weighed quantities, and left over feed residues were collected and weighed the following morning to determine daily feed intake. Fresh and clean water was provided ad libitum in individual buckets throughout the experimental period.

## Live Weight Recording

Experimental animals were weighed fortnightly using an electronic digital weighing balance, prior to morning feeding and watering. Weights were recorded on two consecutive days, and the mean value was considered as the body weight. Total weight gain was calculated as the difference between final and initial body weights.

## Growth Performance Parameters

The ADG and FCR were calculated by using the formula as mentioned below.

$$\text{Average Daily Gain (ADG, g)} = \frac{\text{Final weight (kg)} - \text{Initial weight (kg)}}{\text{No. of days of growth trial}} \times 1000$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Kg feed intake}}{\text{Kg weight gain}}$$

## Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1994). Least-square Analysis of variance was used to test the significance of various treatments and the difference between treatment means was tested for significance by Duncan's Multiple Range and F Test (Duncan, 1955).

## RESULTS

The fortnightly mean body weights (kg) of Nellore brown ram lambs fed the experimental rations are presented in Table 4. The initial body weights of lambs did not differ significantly among the four treatment groups (T1-T4).

**Table 4:** Effect of feeding experimental complete diets on Weight Gain, ADG, DMI, FCR in Nellore ram lambs

| Parameters                     | Complete diets#                        |                                       |                                         |                                          |
|--------------------------------|----------------------------------------|---------------------------------------|-----------------------------------------|------------------------------------------|
|                                | T1<br>(without any chunni:<br>Control) | T2<br>(with Red gram<br>chunni: RGCC) | T3<br>(with Green gram<br>chunni: GGCC) | T4<br>(with Bengal gram<br>chunni: BGCC) |
| Initial weight (Mean ± SE; kg) | 13.26 ± 0.08                           | 13.28 ± 0.06                          | 13.22 ± 0.01                            | 13.27 ± 0.04                             |
| Final weight (Mean ± SE; kg)   | 23.91 ± 0.05                           | 24.26 ± 0.02                          | 23.98 ± 0.05                            | 23.92 ± 0.06                             |
| Total weight gain(kg)          | 10.65                                  | 10.98                                 | 10.76                                   | 10.66                                    |
| Average daily gain (g)         | 88.75 ± 0.90                           | 91.46 ± 0.49                          | 89.69 ± 0.49                            | 88.85 ± 0.49                             |
| Total feed intake (kg)         | 108.27                                 | 109.55                                | 108.38                                  | 108.32                                   |
| Total DMI (kg)                 | 74.63                                  | 79.93                                 | 78.45                                   | 75.21                                    |
| DMI/day (g)                    | 621.90                                 | 666.08                                | 653.75                                  | 626.75                                   |
| FCR (kg feed/kg gain)          | 10.17                                  | 9.98                                  | 10.07                                   | 10.16                                    |

#Each value is an average of eight observations; **DMI** = Dry matter intake; **FCR** = Feed conversion ratio

In the control group (T1), the mean body weight increased from  $13.26 \pm 0.08$  kg at the beginning to  $23.91 \pm 0.05$  kg at the end of the 120-day trial. Corresponding final weights in T2 (RGCC), T3 (GGCC), and T4 (BGCC) groups were  $24.26 \pm 0.02$ ,  $23.98 \pm 0.05$ , and  $23.92 \pm 0.06$  kg, respectively. Statistical analysis revealed no significant difference ( $P > 0.05$ ) in body weights up to the first fortnight. However, from the second fortnight onwards, significant ( $P < 0.01$ ) differences were observed among treatments. Lambs fed experimental complete diets containing red gram, green gram, or bengal gram chunni (T2, T3, T4) showed significantly higher body weights compared to those in the control group (T1).

The average initial and final body weights (kg) of experimental ram lambs fed rations T1, T2, T3 and T4 were  $13.26 \pm 0.08$  and  $23.91 \pm 0.05$ ;  $13.28 \pm 0.06$  and  $24.26 \pm 0.02$ ;  $13.22 \pm 0.01$  and  $23.98 \pm 0.05$ ; and  $13.27 \pm 0.04$  and  $23.92 \pm 0.06$ , respectively (Table 4). The corresponding average weight gains (kg) were 10.65, 10.98, 10.76 and 10.66, while the respective average daily gains (ADG) were  $88.75 \pm 0.90$ ,  $91.46 \pm 0.49$ ,  $89.69 \pm 0.49$  and  $88.85 \pm 0.49$  g. Lambs fed diets containing red gram, green gram, and bengal gram chunnies (T2, T3 and T4) recorded significantly ( $P < 0.01$ ) higher body weight gain and ADG compared to the control (T1). The higher ADG in these groups may be attributed to improved nutrient utilization, higher intake of CP, TDN and ME, and the balanced roughage-to-concentrate ratio, which together provided an optimum rumen environment for efficient microbial protein synthesis (Patil *et al.*, 2019).

Feed conversion ratio (kg feed/kg gain) of ram lambs fed rations T1, T2, T3 and T4 was 10.17, 9.98, 10.07 and 10.16, respectively (Table 4). Ration T2 containing red gram chunni shown better feed conversion efficiency than other three experimental rations. The average daily Dry Matter Intake (DMI) was 621.90, 666.08, 653.75 and 626.75 g in experimental ram lambs fed complete diets T1, T2, T3 and T4, respectively. Statistical analysis revealed that, there was no significant ( $P > 0.05$ ) difference in overall daily Dry Matter Intake (g) among the four experimental diets with or without pulse chunni, but non-significantly higher DMI observed in T2 and T3 groups of lambs.

## DISCUSSION

### Body Weight Gain

The data (Table 4) showed that fortnightly body weights from the 2<sup>nd</sup> to 8<sup>th</sup> fortnight were significantly ( $P < 0.01$ ) higher in Nellore brown ram lambs fed complete diets containing red gram, green gram, or bengal gram chunni (T2, T3, T4) compared to the control (T1). The improved body weight gain and feed efficiency observed with roughage-based complete diets in the present study are consistent with earlier reports in rams and lambs (Haddad and Goussous, 2005; Antunovic *et al.*, 2006; Mahender *et al.*, 2006; Milewski, 2009). The findings also agree with Harikrishna *et al.* (2013), who reported enhanced growth performance of lambs fed complete diets supplemented with thermotolerant yeast.

### Average Daily Gain (ADG)

All the experimental lambs exhibited linear growth from the beginning until the end of the 8th fortnight, with overall average daily gain (ADG) values of  $88.75 \pm 0.90$ ,  $91.46 \pm 0.49$ ,  $89.69 \pm 0.49$  and  $88.85 \pm 0.49$  g for T1, T2, T3 and T4 diets, respectively (Table 4). Significantly ( $P < 0.01$ ) higher body weight gain and ADG were observed in lambs fed T2, T3 and T4 diets compared to T1 (control), indicating the beneficial effect of pulse chunni inclusion in complete rations. The ADG values recorded in the present study were comparable with earlier reports using maize or sorghum stover-based complete rations (Nalini *et al.*, 2012a; Anandan *et al.*, 2013) and with findings in lambs fed oat or gram straw-based complete feed blocks (Yasir *et al.*, 2009; Dhuria *et al.*, 2009). Similar improvements in ADG were also documented in lambs and sheep fed complete rations supplemented with yeast or by-products (Harikrishna *et al.*, 2013; Lailer *et al.*, 2010; Madhavi *et al.*, 2010; Venkateswarlu *et al.*, 2013; Raju, 2018; Vidya, 2021). The present results further corroborate the findings of Haddad (2005), Afzal *et al.* (2008), and Sudheerbabu *et al.* (2013), who reported higher growth performance in small ruminants fed complete diets. On the other hand, lower ADG values have been reported in sheep and goats by Jadhav and Deshmukh (2001), Dhuria *et al.* (2004, 2007a) and Rangamma (2020), possibly due to differences in diet composition, breed and management practices.

### Feed Conversion Ratio (FCR)

The feed conversion ratio (kg feed/kg gain) of Nellore ram lambs fed rations T1, T2, T3 and T4 was 10.17, 9.98, 10.07 and 10.16, respectively (Table 4). Among the treatments, ration T2 containing red gram chunni showed numerically better feed conversion efficiency; however, statistical analysis revealed no significant differences in FCR among the experimental diets. The FCR values obtained in the present study were comparable with those reported by Venkateswarlu (2011), Vidya (2021) and Sudheerbabu *et al.* (2013) in lambs fed cereal stover-based complete diets. Similar feed efficiency was also observed by Raju (2018) in lambs maintained on sorghum stover-based complete feed blocks. The comparable FCR values across treatments in the present study may be attributed to similar nutrient utilization patterns, optimum roughage-to-concentrate ratio, and balanced nutrient intake that supported uniform growth performance.

### Dry Matter Intake (DMI)

The daily average dry matter intake (DMI; g) of Nellore ram lambs fed experimental diets T1, T2, T3 and T4 during the 120-day growth trial was 621.90, 666.08, 653.75 and 626.75 g, respectively (Table 4). Statistical analysis revealed no significant ( $P>0.05$ ) difference in overall DMI among the four groups, although numerically higher intakes were observed in lambs maintained on T2 and T3 diets. The comparable DMI values across treatments indicate that all diets were well accepted by the animals and met the nutrient requirements suggested by ICAR (2013). Similar observations on the adequacy of DMI in small ruminants fed complete diets were reported by Reddy *et al.* (1994a), Samantha *et al.* (2003), Mane *et al.* (2006), Dhuria *et al.* (2007b), Afzal *et al.* (2008), Harikrishna *et al.* (2013), and Raju (2018). Variations in DMI among studies may be attributed to differences in feed texture, initial body weight, environmental conditions, crude fibre content and rumination time, as feed intake in ruminants is primarily influenced by the nature of roughage and the roughage-to-concentrate ratio in the diet (Forbes, 1986; Van Soest, 1994; Haddad, 2005).

### CONCLUSION

The present study evaluated the growth performance of Nellore ram lambs fed

sorghum straw-based complete diets with or without pulse chunni inclusion. Among the treatment groups, lambs fed the T2 diet (15% red gram chunni) showed significantly ( $P<0.01$ ) higher body weight gain, ADG, and better feed conversion ratio compared with the control (T1). Feed intake and DMI were also higher in the T2 group, supporting enhanced nutrient utilization.

It can be concluded that inclusion of red gram chunni at **15% level in sorghum straw-based complete diets** improves nutrient availability, enhances growth performance, and reduces cost of meat production in Nellore brown ram lambs without any adverse effects on animal health.

### Conflict of Interest

On behalf of all the co-authors hereby, I declare that there is no conflict of interest for the manuscript entitled **“Effect of feeding pulse chunni based complete diets on growth in Nellore brown ram lambs”** Moreover, I declare that all the other authors fully agree on its content, and approve the text. This manuscript describes an original work and it is not under consideration by any other journal and has never been published before in any form.

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### Ethics Declaration:

None of the data were deposited in on official repository. Raw data supporting the findings of this study are available from the corresponding author [J.K.] on request.

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