COMPARATIVE STUDY ON THE EFFECT OF RICE WATER AND RICE PORRIDGE ON THE GROWTH AND PHYTOCHEMICAL PROFILE OF CAPSICUM ANNUM

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ABSTRACT:

Rice-water is a nutrient-rich enriched solution that contains amino-acids, vitamins (A, B, C and E), antioxidants and phenolic compounds, flavonoids etc. If for some special reasons you can't use it for your skin, it's also good idea to adopt rice water for gardening. Those bioactive elements have NPK (nitrogen, phosphorus, potassium) which means rice water is a eco-friendly alternative to chemical fertilizers and contribute to grow health and strong plants. The objective of the present study was to compare the effect of rice wash water (RRW), rice porridge (RP), and tap water (TW) on growth characteristics and phytochemical content of Capsicum annuum, a pharmacologically important plant commonly consumed in the Mediterranean diet. A controlled pot experiment under the shade house conditions was performed over a 13-week period outdoors in pots (40 × 40 × 60 cm) containing 7 kg of soil (thirty pots) at the temperature range of 25-30 °C. J) Rice water (Rice porridge), Tap water applied at 50% of field capacity before sowing and for irrigation at the time of experiment. Three seeds of each variety were sown in each pot. Growth characteristic (plant height, number of leaves, and fruit yield/game) was measured weekly. Phytochemical screening of the ethanolic extracts of leaf and fruit of Capsicum annuum was carried out.

KEY WORDS: Rice Wash Water, ,Rice Water, *Capsicum annum,* Phytochemical screening, Plant growth, Phytochemical screening,.

INTRODUCTION

The high rate of population growth in many developing countries, particularly in India, has placed a heavy stress on the natural resources. Wastage of water in domestic, agricultural, and industrial fields has plummeted to an alarming position of deficit of freshwater resources. Such a growth in demand therefore highlights the imperative requirement for the sustainable management of water-use, and mostly in agriculture, the highest water-consuming sector worldwide. Part of this environmental and economic equation is one that is perhaps all too familiar to me: reusable household by-products, such as rice water, rice it contains a wealth of carbohydrates, amino acids, B-vitamins and trace elements. The effluent also containssignificant levels of some micronutrients: (0.80% of vitamin B1; 0.70% of vitamin B3; 0.90% of vitamin B6; 0.50% of manganese, 0.2944% calcium, 0.252% of magnesium, 0.027% of sulfur and 0.0427% of iron). It also supplies the macronutrient of nitrogen (0.015%), phosphorous (10.31%) and potassium (0.02%). Those are the macronutrient elements, such as nitrogen (N), phosphorus (P), and potassium (K), which are necessary for the preservation of basic metabolic and physiological process in plants. Their bioavailability for soils system is, however, very limited and cannot satisfy the need of plant growth, so the additional application of fertilizer is needed. For the former, rinsing water of rice can reduce it by promoting hormone synthesis, nutrient transportation and the shoot development. Additionally, the product has the function of controlling the growth of pathogens, reducing the stress of transplanting, increasing the photosynthesis, preventing the wilt and promoting flowering. Together, these characteristics indicate its utility as a natural biostimulant in integrated and sustainable nutrient management practices. Capsicum annuum (red chilli pepper) belongs to the family solanaceae, grown as an annual or biennial herbaceous crop, and has enormous dietary and commercial importance globally, especially in India. It is valuable because of its unique characteristics, such as bright color and pungency, and also due to its flavor and morphological diversity, so that it can be used as a fresh and dry ingredient in the food industry. In 2020, the world production of fresh green chillies was 36 million tonnes, with China producing 46% of the world total. In India, Andhra Pradesh is the leading producer of chilli, followed by Telangana, Madhya Pradesh, Karnataka and Odisha. Some of the popular Indian kinds such as Bhut Jolokia, Guntur, Kashmiri, Byadagi, Dalle Khursani among others are famous not only for their taste but also for their medicinal properties. Morphology C. annuum is a compact shrub 1.8 meters in maximum height and 1 meter in maximum width, and commonly grown as an annual plant, although C. annuum may live for several years in warmer climates. Ripened red fruits are a rich source of pungency, aroma and bioactive compounds and differ significantly in size and shape. Due to its high agronomic and pharmaceutical values, the sustainable farmers are willing to change the cultivation and caliber of Capsicum annuum significantly. Low-output foods such as rice grains, rice water and rice porridge, which had previously been regarded as kitchen waste, have recently gained attention as low-cost, nutrient rich substitutes of chemical fertilizers. Through characterization of these effects, the study seeks to assess the potential of rice/anaerobic treatment waste for enhancing plant performance compared to tap water based irrigation for use in waste valorization and ecosystem based sustainable agriculture.

MATERIALS AND METHODS

Materials

The experimental materials which include the certified seeds of Capsicumannuum and white rice and were bought from Sri Durga Bhavani store, Vijayawada, A.P., India. The other material used to supplement the treatment are plastic pots (40 × 40 × 60 cm), spraying bottles, measuring cup and a metric ruler. The control irrigation source was tap water.

For phytochemical screening, the following analytical-grade chemicals and reagents were purchased from Merck. These chemicals were namely; sulfuric acid (H_2SO_4), ferric chloride ($FeCl_3$), hydrochloric acid (HCl), acetic anhydride, glacial acetic acid, zinc dust, aluminum chloride ($AlCl_3$), Dragendorff's reagent, Mayer's reagent and Liebermann–Burchard reagent.

Methodology

Pot Experiment

A 13-week greenhouse pot culture experiment under natural conditions (25 ± 5–30 ± 5°C) was performed and 30 pots were evenly classified into three treatments including (1) rice water, (2) rice porridge and (3) tap water (control). There were 10 pots for each treatment. Before seeding, all pots were pre-treated with 50% of the different treatment solutions.

Preparation of Rice Water

The rice water treatment involved washing 250 g of white rice in 1000 mL of tap water. When the rice was washed, there were manually swirled fives time for starch coming out. The starchy water obtained was strained, further diluted, and 500 mL was applied as irrigation.

Preparation of Rice Porridge

For rice porridge-making, 250 g of rice was first rinsed with 250 mL of tap water by manually swirling, as described above. Rice was next boiled with 1000 mL of water for 30–60 min until a porridge was formed. After being cooled off, 50mL of the porridge was taken and used to irrigate the respective pots.

Planting and Irrigation

Each pot received three seeds of Capsicum annuum. The different treatment solutions were administered during the experimentation day. Plant height, number of leaves, flowers and fruits were recorded at 30, 60 and 90 DAT for growth parameters. Four replicates for each treatment were sampled and analysed with the mean value.

Growth and Yield Parameters

Height of Plant (cm): It was recorded at 30, 60 and 90 days after transplantation with the ruler from the soil surface to shoot apex including stem base.

Leaf Number: Taken at 30, 60 and 90 days after transplant (DAT) with an average of four replication.

Number of Flowers: Open flowers were recorded at all time intervals and means taken of replicates.

Fruit number: Fruits were counted at 30, 60, and 90 DAA from the harvest and the average were calculated from replicates.

Preliminary Phytochemical Screening

Sample Collection and Preparation

Leaves and fruits of 90 Capsicum annuum plants were harvested and air-dried at the end of the experimental period. The dry samples were powdered well in the pre’heated mixer grinder.

Ethanolic Extraction

A Soxhlet extraction of 10 g of powdered material (leaves and fruits) was performed with 100 mL of ethanol. The extracts were evaporated at 25°C to dryness to give a solid residue. These were dissolved in ethanol having various concentrations for the purpose of phytochemical screening.

Phytochemical Analysis

Qualitative phytochemical analysis was carried out on leaf and fruit ethanolic extracts according to standard procedures. The presence of tannins, alkaloids, steroids, phenols, terpenoids and flavonoids was detected in the analysis.

Category	Details
Plant Material	Certified *Capsicum annuum* seeds (Sri Durga Bhavani Store, Vijayawada, A.P., India)
Other Materials	White rice, plastic pots (40 × 40 × 60 cm), spray bottles, measuring cups, metric ruler
Control	Tap water
Chemicals/Reagents	H_2SO_4, $FeCl_3$, HCl, acetic anhydride, glacial acetic acid, Zn dust, $AlCl_3$, Dragendorff’s reagent, Mayer’s reagent, Liebermann–Burchard reagent (Merck, analytical grade)
Experimental Setup	30 pots divided into 3 treatments (Rice water, Rice porridge, Tap water)

Category	Details
	with 10 pots each
Rice Water Preparation	250 g rice washed in 1000 mL water (swirled 5×), starchy water filtered, diluted; 500 mL applied
Rice Porridge Preparation	250 g rice rinsed in 250 mL water, boiled in 1000 mL water (30–60 min), cooled; 50 mL applied
Planting	3 seeds of *Capsicum annuum* per pot
Growth Parameters	Plant height, leaf number, flower count, fruit count measured at 30, 60, and 90 DAT
Sample Collection	Leaves and fruits from 90 plants harvested, shade-dried, ground into powder
Extraction Method	10 g powdered material extracted in Soxhlet with 100 mL ethanol
Phytochemical Screening	Tannins, alkaloids, steroids, phenols, terpenoids, flavonoids identified

Results

Plant Height (cm)

The effect of different irrigation treatments on the height of *Capsicum annuum* is summarized in Table 1. Measurements were taken at 30, 60, and 90 days after transplanting (DAT). Plants irrigated with rice water exhibited significantly greater growth compared to those treated with rice porridge or tap water.

At 30 DAT, rice water–treated plants reached an average height of 28.72 ± 0.23 cm, which was higher than rice porridge (25.43 ± 0.34 cm) and tap water (23.25 ± 0.28 cm). By 60 DAT, the rice water group recorded a mean height of 56.69 ± 0.37 cm, surpassing rice porridge (52.06 ± 0.66 cm) and tap water (46.52 ± 0.35 cm). The maximum plant height was achieved at 90 DAT, where rice water treatment resulted in 80.59 ± 0.39 cm, while rice porridge and tap water recorded 61.15 ± 0.39 cm and 54.54 ± 0.40 cm, respectively. These findings clearly indicate that rice water irrigation significantly promotes plant height compared to the other treatments, highlighting its potential as a low-cost and eco-friendly growth enhancer.

Table 1. Plant height (cm) of *Capsicum annuum* under different irrigation treatments

S. No.	Time Interval (Days)	Rice Water (cm)	Rice Porridge (cm)	Tap Water (Control) (cm)
1	30 DAT	28.72 ± 0.23	25.43 ± 0.34	23.25 ± 0.28
2	60 DAT	56.69 ± 0.37	52.06 ± 0.66	46.52 ± 0.35
3	90 DAT	80.59 ± 0.39	61.15 ± 0.39	54.54 ± 0.40

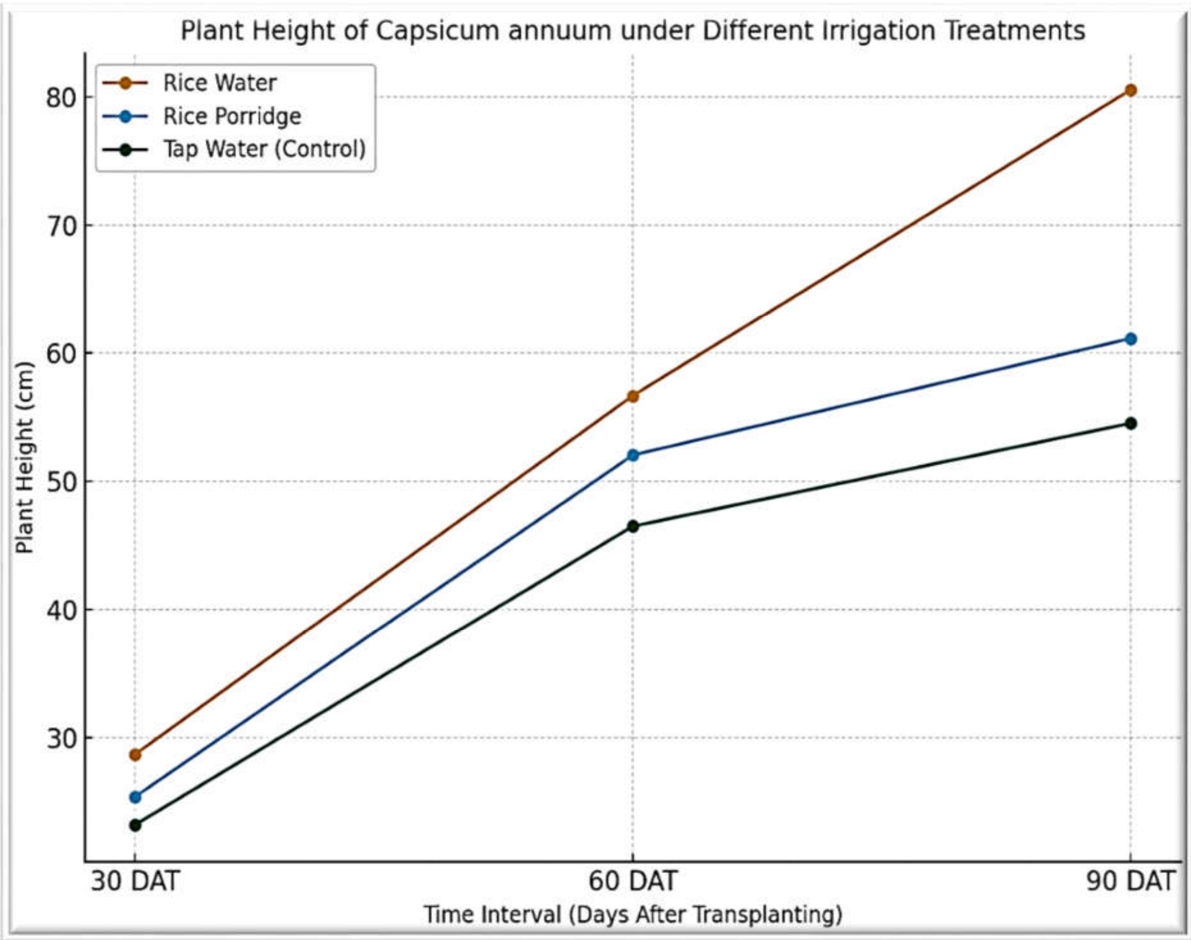


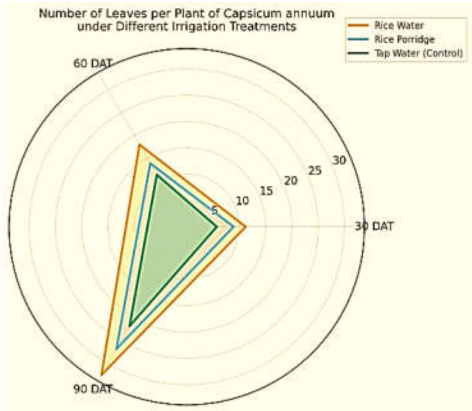
Figure 2. Growth of Capsicum annuum plants at 60 days after transplanting, treated with tap water, rice porridge, and rice wash water (from left to right).

Number of Leaves per Plant

As shown in Table 2, rice water-treated plants exhibited the highest number of leaves at all intervals. At 90 days, the leaf count reached **32.5 ± 0.84** in rice water treatment, compared to **26.8 ± 0.73** in rice porridge and **21.8 ± 0.91** in tap water-treated plants.

Table 2. Number of leaves per plant of *Capsicum annuum* under different irrigation treatments

S. No.	**Time Interval (Days)**	**Rice Water (Mean ± SE)**	**Rice Porridge (Mean ± SE)**	**Tap Water (Control) (Mean ± SE)**
1	30 DAT	11.2 ± 0.78	8.9 ± 0.73	5.7 ± 0.82
2	60 DAT	18.0 ± 0.66	13.9 ± 0.99	11.4 ± 0.69
3	90 DAT	32.5 ± 0.84	26.8 ± 0.73	21.8 ± 0.91



The effect of different irrigation treatments on leaf production in *Capsicum annuum* is presented in Table 2. A steady increase in leaf number was observed across all treatments from 30 to 90 days after transplanting (DAT). At 30 DAT, plants irrigated with rice water produced the highest average leaf count (11.2 ± 0.78), followed by rice porridge (8.9 ± 0.73) and tap water (5.7 ± 0.82). By 60 DAT, rice water treatment again outperformed the others, recording 18 ± 0.66 leaves, compared with 13.9 ± 0.99 for rice porridge and 11.4 ± 0.69 for tap water. At the final observation (90 DAT), rice water irrigation supported maximum leaf development (32.5 ± 0.84), while rice porridge and tap water treatments recorded 26.8 ± 0.73 and 21.8 ± 0.91, respectively. These results demonstrate that rice water irrigation markedly improves leaf formation, indicating enhanced vegetative growth compared to rice porridge and the control treatment.

Results

Number of Fruits per Plant

The influence of irrigation treatments on fruit formation in *Capsicum annuum* is presented in Table 3. A progressive increase in fruit number was observed across all treatments from 30 to 90 days after transplanting (DAT). At 30 DAT, no fruits were recorded in the rice water and tap water treatments, whereas rice porridge irrigation produced a mean of 0.6 ± 0.51 fruits. By 60 DAT, rice porridge continued to promote higher fruit set (6.8 ± 0.42) compared to rice water (2.4 ± 0.51) and tap water (1.3 ± 0.48). At 90 DAT, rice porridge recorded the maximum fruit yield (11 ± 0.47 fruits per plant), followed by rice water (8 ± 0.66) and tap water (5.2 ± 0.42). These findings demonstrate that while rice water was more effective for vegetative growth, rice porridge treatment supported greater fruit productivity.

Table 3. Effect of irrigation treatments on fruit development in *Capsicum annuum*

S. No.	Time Interval (Days)	Rice Water (Mean ± SE)	Rice Porridge (Mean ± SE)	Tap Water (Control) (Mean ± SE)
1	30 DAT	0	0.6 ± 0.51	0
2	60 DAT	2.4 ± 0.51	6.8 ± 0.42	1.3 ± 0.48
3	90 DAT	8.0 ± 0.66	11.0 ± 0.47	5.2 ± 0.42

Biomass Accumulation (Wet and Dry Weight)

Biomass production was strongly influenced by the type of irrigation applied. Rice water–treated plants exhibited the maximum biomass, recording a wet weight of 100 g and a dry weight of 20 g. Plants irrigated with rice porridge achieved moderate biomass (wet: 80 g; dry: 12 g), whereas tap water treatments resulted in the lowest values (wet: 65 g; dry: 8.125 g). This indicates that rice water irrigation enhances overall vegetative biomass, while rice porridge has a stronger influence on fruit development.

Preliminary Phytochemical Screening

The results of phytochemical screening for ethanolic extracts of leaf and fruit samples are summarized in Table 4. Both extracts tested positive for flavonoids and saponins. Phenols and triterpenoids were detected exclusively in the leaf extracts, while alkaloids and tannins were absent in both tissues.

Table 4. Phytochemical profile of ethanolic extracts of *Capsicum annuum*

S. No.	Phytochemical Constituents	Leaf Extract	Fruit Extract
1	Alkaloids	---	---
2	Flavonoids	+++	+++
3	Saponins	+++	+++
4	Tannins	---	---
5	Phenols	+++	---
6	Triterpenoids	+++	---

Note: (+++) Presence; (---) Absence

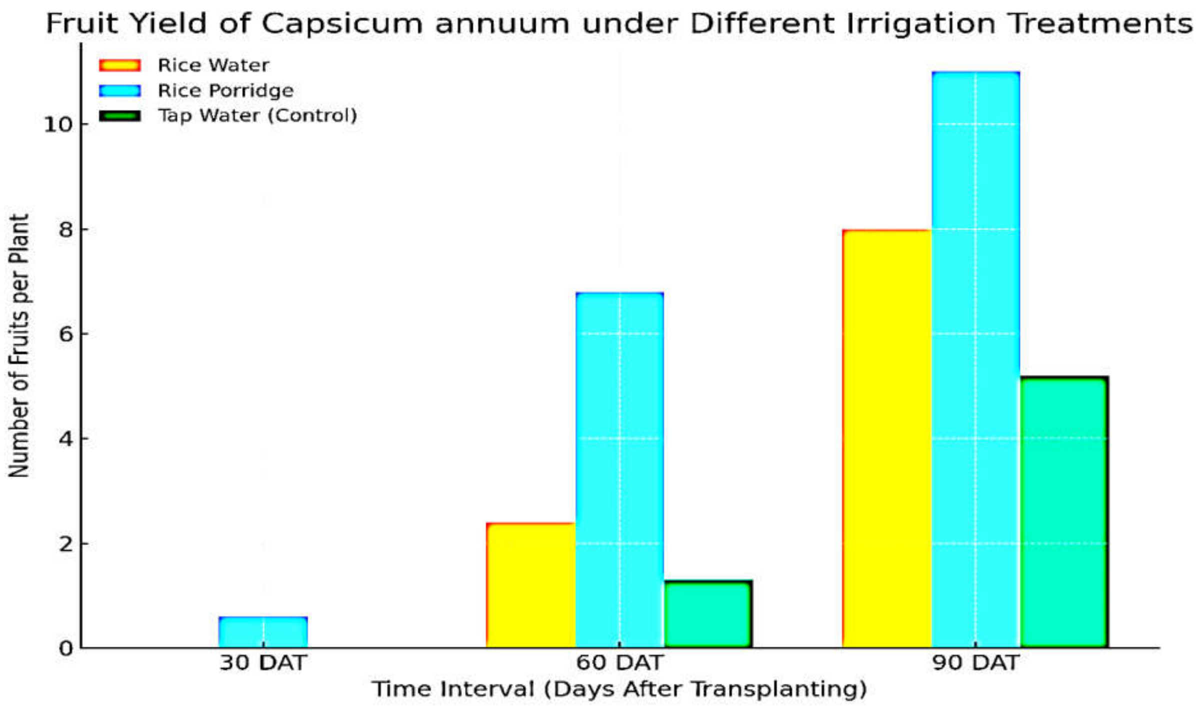


Diagram – Fruit Yield under Different Irrigation Treatments

Here's the **bar chart** showing fruit yield of *Capsicum annuum* under rice water, rice porridge, and tap water treatments across 30, 60, and 90 DAT.

DISCUSSION:

Based on the assessment of growth indices in Capsicum annuum, there was a marked variation in different irrigation treatments. The only trend noted was the higher vegetative growth of the rice water–treated plants as evident by the more height of plants and number of leaves compared with average or lower of other treatments. One can compare these findings with those from Febriyanti et al. (2021) who reported rice wash water enhances the growth of the plant in terms with leaf expansion and shoot growdth. Its positive contribution may be attributed to the remaining residual starch, micronutrients, and organic acids in the rice water that would enhance solubility of nutrient elements, roots, and growth performances. In relation to reproductive growth, plants treated with rice porridge had the highest number of fruiting bunches at 90 DAT. This indicates that the adhesive porridge nutrient-rich sticky viscous solution is also more conducive to fruit setting, ripening than rice water.

Nevertheless, rice water was more effective than the control (tap water), suggesting rice water as a growth-inducing cue. Biomass accumulation also exhibited a consistent pattern with highest wet and dry weights of rice water treated plants. This highlights its role in improving physiological efficiency and source-sink relationships. For rice-stra applications, intermediate biomass and higher response of fruit yield were observed and the troughest water condition for all traits was the tap water. Phytochemical screening also established the presence of basic bioactive metabolites. Flavonoids and saponins were present in the leaf and fruit extracts as well and phenols and drugs page were detected in the leaf only. These bioactive compounds are nutraceutical molecules of nutraceutical significance and their levels may be influenced by nutrient dynamics due to rice culture irrigation practices. In general, our results (Figures 1–6) suggest that rice water is the main substrate supporting vegetative growth and biomass formation, whereas rice porridge appears to support reproductive output. Both of these suggest that the worth of rice could be ransomed in the way of by-products for the sustainable and economical produce of crops.

.CONCLUSION:

The result clearly indicated that rice wash water recorded the highest effect on the vegetative growth of brinjal. This was consistent as well with the cumulative effect on biomass accumulation by the control to that obtained for rice-produced treatments in terms of wet and dry weights. The phytochemical analysis further corroborate these results reflected in higher metabolic level linked with better nutrient availability from R inputs. There was remarkable positive influence of rice wash water and rice porridge applications on yield components as well as vegetative growth too. It was interesting to note that serial applications of rice porridge irrigation achieved the highest fruit yield, indicating its importance to the reproductive phase and rice wash water maintained superior fruiting crop and plant vigor over the control. Prospective studies should replicate the practice of macronutrient and micronutrient analysis of rice wash water and rice gruel in standardized formulations. Increased understanding of their mode of action will lead to their development as useful components for sustainable crop management and to increase their applications as natural growth stimulators in agriculture.

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