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Effect of Aquarium Water and Kitchen Waste Water on the Germination and Growth of Brinjal, Chilli, Balsam and Greens

Samiha Begum A. and Amtuz Zehra*

P.G. and Research Department of Zoology, Justice Basheer Ahmed Sayeed College For Women, Teynampet, Chennai, India

*Corresponding Author

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Abstract: This study was undertaken to analyze a comparative study for the growth of diverse ornamental and vegetative plants such as Brinjal (*Solanum melongena*), Chilli (*Capsicum annum*), Balsam (*Impatiens balsamina*) and Greens (*Amaranthus*). Based on the utilization of different water alternatives, such as aquarium water and kitchen wastewater, this study ensures to procure an appropriate alternative to tap water that provides plants with healthy growth under adverse conditions of water scarcity. Water is a basic component of plant growth, under harsh conditions of replacing sparkling or fresh water for growing plants, which type of water alternative helps provide the best growth? We examined this study based on the plant growth observation, with a setup each of 3 sets, one set for the control; the other two were assessed for kitchen wastewater and aquarium water accordingly. The period of this examination was for about 40 days. Under the provision of nutrient supplements and a deliberate water quantity of 500 ml, our study was carried out. The growth ratio was observed by the germination rate, leaves count, and the height of the plants.

Keywords: Kitchen waste water, Germination, Aquarium waste water, Ornamental plant growth, Vegetative plant growth, Tap water

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Introduction

The demand for water among various sectors has tremendously increased due to population expansion and economic advancements. Throughout the years, water has been a prime necessity to preserve all ecological aspects, from propellant plant growth to being a plentiful resource for multi-purposes in our ecological spaces. Contemplating its excessive utility, water scarcity has been a wild threat to regulate ecological growth, human health and food sufficiency in most of the arid regions around the globe.

The emergence of competition in the water amongst divinities has predicted over 348 million people which may face severe water scarcity. According to a recent IWMI research (Seckler *et al.,*1998), we estimated that nearly 1.4 billion people, amounting to a quarter of the world's population, or a third of the population in developing countries, live in regions that will experience severe water scarcity within the first quarter of the next century.

Due to overexploitation of water resources, Climate adversaries and population outgrowth all exclaim clear inclination of water declination. Climate change is expected to produce significant effects on global water resources and freshwater ecosystems (Sheikh Mohammad *et al.,* 2017).

Rapid growth of urban population results in generation of huge quantities of wastewater perennially. In India only 30% of the wastewater is treated before it's discharged. Thus, untreated water finds its way into water systems such as rivers, lakes, groundwater and coastal waters, causing serious water pollution (GOI, 2002).

The severity of this issue will have a direct impact on the water and food security of the country in future. Factors support in the predicament of scarce water procurement, and state how we require processing in alternate resources to help facilitate plant growth. Implementing alternative water projects requires careful planning to ensure that the right water sources are collected for the most appropriate uses.

Therefore, the country still requires continued efforts of the government along with external aids especially in the issues of global climate change and consumer awareness on water conservation. In addition, they not only protect and conserve the environment but also contribute to security of the poor with food security (David and Barker, 1999).

This introduced ecological questions about the adaptation of plants to dry environments and the relation to transpiration efficiency. Counterintuitive results stimulated the discussion and linked differences in WUE to different ecological strategies (Brendel, 2021).

Alternative water can serve as a vital water supply to federal agencies in support of water resilience by providing diverse water sources. We look upon our potent water alternative for this study--

- Kitchen Wastewater
- Aquarium water

Discharged water from water purification processes of foundation water blow down water or Desalinated water. Implementing alternative water projects requires careful planning to ensure that the right water sources are collected for the most appropriate uses.

Singh *et al*. (2004) used sewage water for irrigation of several crop plants including wheat, gram, palak, methi and berseem. The use of water for agricultural production in water scarcity region requires innovative and sustainable research and appropriate transfer of technologies.

Formulated aqua feed is a crucial input that represents a substantial operating cost for any intensive aquaculture operation (El-Sayed 1999, 2004). High protein content in formulated feeds provides rapid fish growth and high yields, and fishmeal has generally been the preferred source of protein. The aquaculture effluent often contains abundant nitrogen (derived from amino acids in the feed) and phosphorus, it is often lacking in other important plant nutrients such as potassium and chelated iron (Rakocy *et al.*, 2004, 2006). To date, no studies have examined the effect of aqua feed on aquaponic plant productivity. Balsam, brinjal, A*maranthus* and chilli were subjected to kitchen waste water and aquarium water in order to study the germination, shoot length and root length.

Luistal (2002) reported some of the aspects, mainly on farm irrigation management including the use of treated waste water and saline water. Wang *et al.* (2017) conducted a study in green house to evaluate the impact of replacing mineral fertilizer with organic fertilizers on soil fertility.

Balsam and chili plant fertilized with kitchen waste water showed better growth when compared to plants fertilized with aquarium water. Similar results were obtained by Arakeline *et al*. (2018) who worked on composition of household organic waste and its effects on tomato plant. Mala *et al*. (2013) reported the influence of organic fertilization on the mineral composition of tomato leaves.

Zahangir and Peter (2017) studied the effect of different organic waste on soil properties and plant growth and yield. Giannakis *et al*. (2014) investigated the impact of municipal solid waste compose application on the growth of lettuce and tomato plant.

Balsaminaceae family (Gardeners, 2017) is a fast growing summer annual flower, with gardenia like blooms(Tooke and Battey, 2000). Continuous blooms grow on top of a bushy plant with leaves. The balsam is originated in Asia, North America and South Africa and there are numerous annual and perennial varieties (Christopher, 2013). Brinjal (*Solanum melongena)* has an increasing demand. This is due to the increasing awareness along with the rapid growth toward the benefit of vegetables in fulfilling the nutrient of the family (Jumini and Marliah, 2009). According to Sowinska and Krygier (2013), eggplants contain low calorie and high nutrient. Chilli (*Capsicum annum* L.) is one of the important vegetable crops of the Solanaceae family and is grown worldwide in large scale. Greens(*Amaranthus* species) are native to the Americas, and an additional 25 species are present in the temperate and tropical regions of Africa, Asia, Australia, and Europe (Sauer, 1967).

The objective of this study was to examine the effects of the alternatives of water such as aquarium water and kitchen waste water on germination of *Solanum melongena*, *Capsicum annuum*, *Impatiens balsamina* and *Amaranthus* sp. and to compare the growth rate for different results on plant growth, respectively.

Materials and Methods

Materials:

Seeds of brinjal (*Solanum melongena),*chillies (*Capsicum annuum*) balsam (*Impatiens balsamina*) and greens (*Amaranthus*) were used for the experiment.Brinjal, Chillies, Balsamand greens were irrigated using kitchen waste water and aquarium water in different labelled earthern pot. Each contained 1 kg of inceptisol soil that were used for the study.The soil of the study sites is classified as Inceptisol, and is pale brown in color and sandy loam in texture (58 % sand, 15 % silt, and 27 % clay). The observation of the plant growth was initiated through three sets of pots each per plant species. These pots were treated well as we kept aside control sample for each plant species; one set of each plant species were allotted to the kitchen waste water and the other set of earthen pots were allotted to the aquarium water, respectively. The germination percentage was studied. The experiment was carried out for 40 days. Straight-shoot length, height from shoot tip to root tip and number of leaves were observed (Fig. 1).

Statistical analysis

Data collected from the experiments were subjected to mean, range and standard deviation.

Results

A wide range of variability in respect of various growth parameters viz. length of leaves, plant shoot and plant root height were recorded. The following plant species were labeled as A , B, C; each of which were exposed to different water compositions of water samples (40 days)--

A- Control

B- Kitchen Waste Water

C- Aquarium Water

Plant growth analysis:

Plant growth analysis is required to explain the differences in between species growing under same environmental condition or differences

Fig. 1: Setup of the plant samples in three rows treated to different water compositions.

(a) Brinjal species analysis (b) Balsam species analysis

(c) Greens species analysis (d) Chilli species analysis

Fig. 2 a-d: The visualization of plant growth analysis.

within a species growing in different environments. The germination days, height from shoot tip to root tip, shoot length, number of leaves, number had more or less expressed a healthy growth when exposed to the kitchen waste water and the aquarium water while comparing them treated with tap water (Fig. 2).

Balsam (*Impatiens balsamina*):

In all of the water samples, Balsam had the most branches with healthy growth. It had adequate growth of 24.7 cm in control (A), 31.7 cm in kitchen waste water (B), and about 26.7 cm branch growth in aquarium feed water (C) (Table 1; Fig. 3).

Table 1: Analysis of the shoot length

S. No.	Particulars	Shoot Length (cm)		
		Control	tchen Waste Water	Aquarium Water
1.	Balsam (*Impatiens balsamina*)	24.7	31.7*	26.7*
2.	Brinjal (*Solanum melongena*)	11.7	11.7*	14.7*
3.	Chilli (*Capsicum annum*)	8.7	14.7*	31.7*
4.	Greens (*Amaranthus*)	12.7	14.7*	24.7*

* indicates significant difference as compared to control

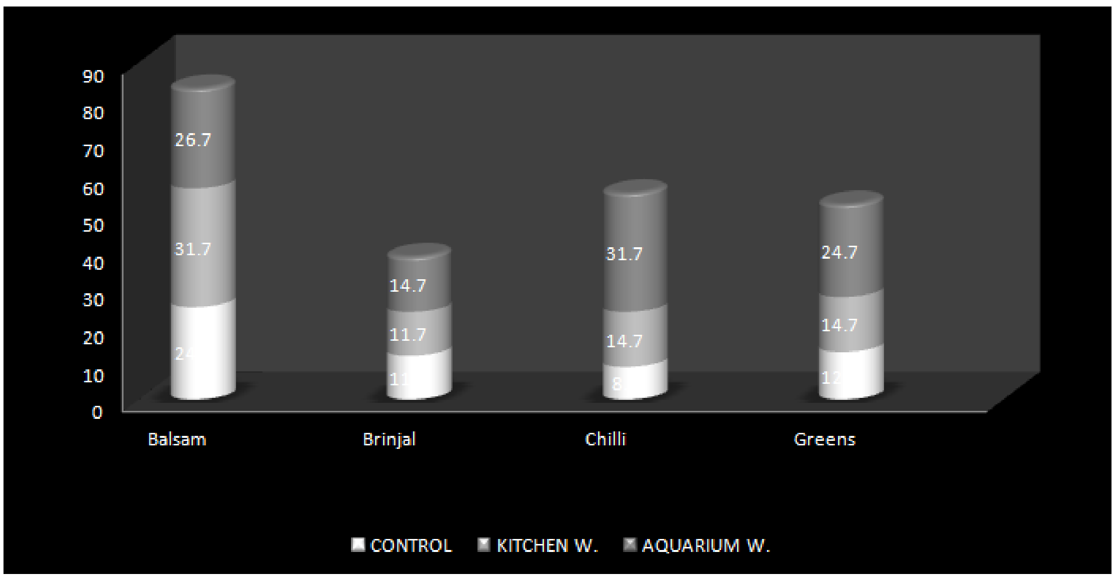

Fig. 3: Shoot analysis on different water compositions.

Besides this, an enriched growth of root length in Balsam was observed of 1.7 cm in control (A), approximately 2.7 cm in kitchen waste water (B), and 1.7 cm in aquarium water (C) (Table 2; Fig. 4).

Similarly, the growth of Balsam leaves was found to be long-winded and healthy. the growth of the leaves were observed to be 1.57 cm in control (A), around 24.5 cm length in kitchen waste water (B), and 19.7 cm in aquarium water (C) (Table 3; Fig. 5).

The most prominent growth was observed in Balsam among all plant species. In comparison to aquarium water and the control in Balsam, the growth observed in kitchen waste water produced the highest growth result (Fig. 6).

Brinjal (*Solanum melongena*):

The observed branch growth in Brinjal was moderate, with 11.7 cm in control (A), 11.7 cm in kitchen waste water (B), and 14.7 cm in aquarium feed water (C) (Table 1; Fig. 3).

Furthermore, it demonstrated enhanced root length growth of 3.7 cm in control (A), nearly 2.7 cm in kitchen waste water (B), and 3.7 cm in aquarium water (C) (Table 2; Fig. 4).

Table 2: Analysis of the root length

S. No.	Particulars	Root Length (cm)		
		Control	Kitchen Waste Water	Aquarium Water
1.	Balsam (*Impatiens balsamina*)	1.7	2.7*	1.7*
2.	Brinjal (*Solanum melongena*)	3.7	2.7*	3.7*
3.	Chilli (*Capsicum annum*)	1.0	1.3*	1.0*
4.	Greens (*Amaranthus*)	1.3	1.7*	2.7*

* indicates significant difference as compared to control

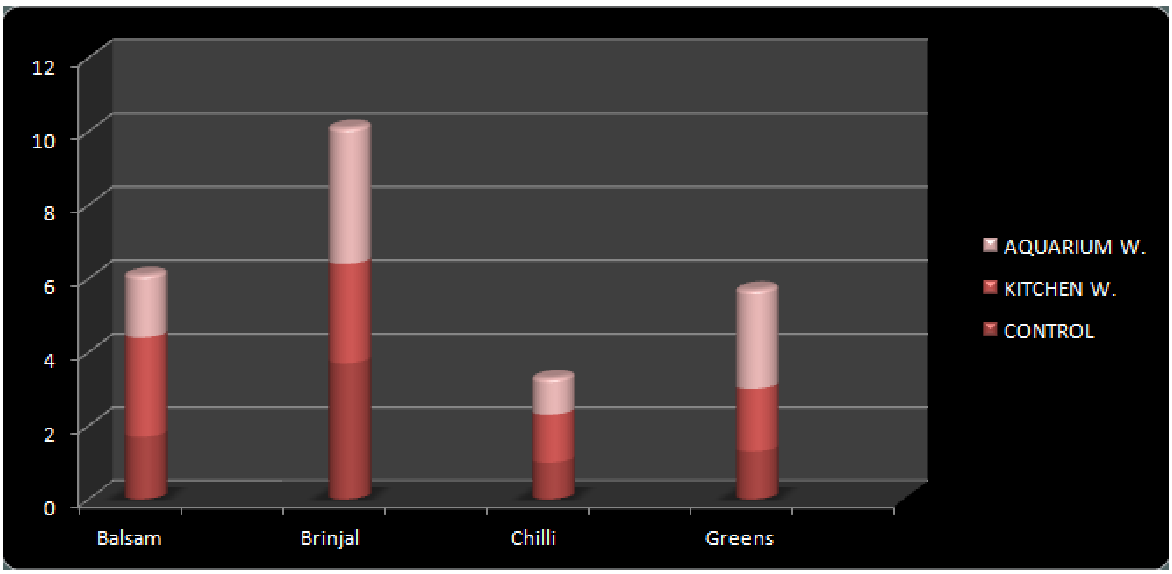

Fig. 4; Root analysis on different water compositions.

Table 3: Analysis of the leaves length

S. No.	Particulars	Leaves Length (cm)		
		Control	Kitchen Waste Water	Aquarium Water
1.	Balsam (*Impatiens balsamina*)	15.7	24.7*	19.7*
2.	Brinjal (*Solanum melongena*)	2.7	4.7*	6.7*
3.	Chilli (*Capsicum annum*)	8.7	11.7*	7.7*
4.	Greens (*Amaranthus*)	6.7	1.7*	14.7*

* indicates significant difference as compared to control

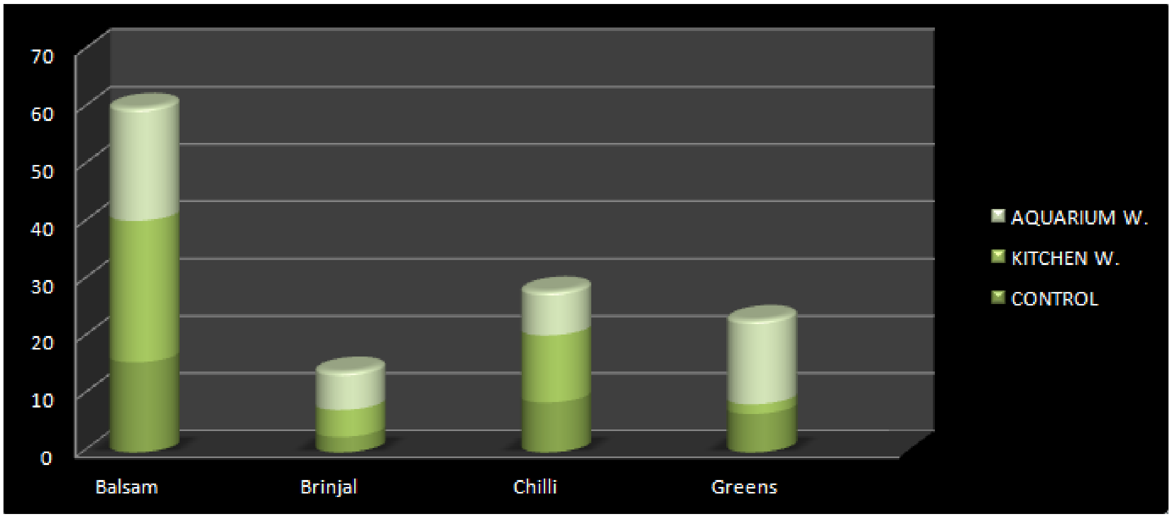

Fig. 5: Leaves analysis on different water compositions.

Fig.6: Balsam growth parameters which exhibit efficient growth status in kitchen waste water.

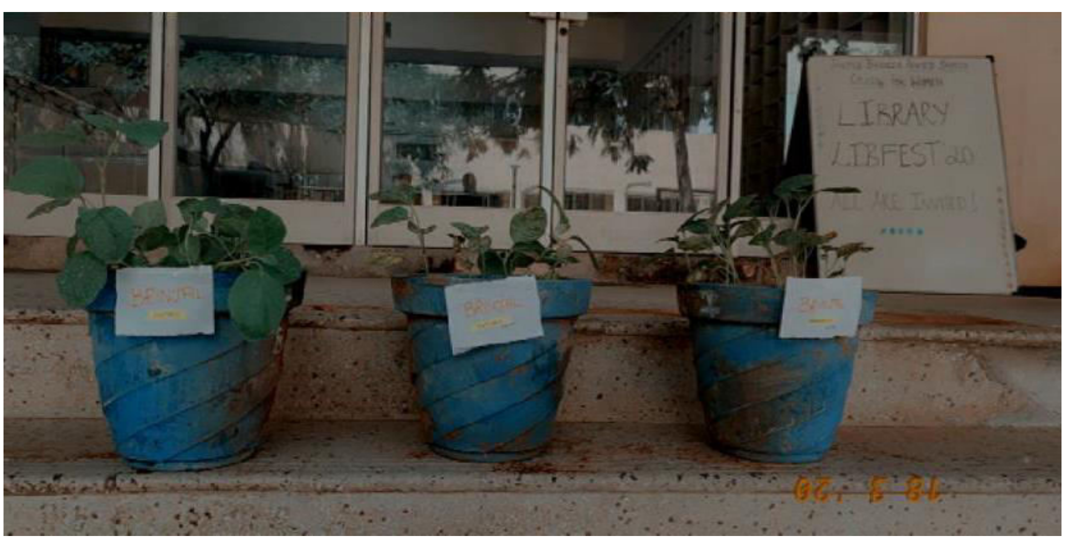

Fig. 7: Brinjal growth parameters which exhibit efficient growth status in aquarium water.

Fig. 8: Chilli growth parameters which exhibit efficient growth status in kitchen waste water.

Fig. 9: Greens growth parameters which exhibit efficient growth status in aquarium water.

Brinjal grew broad and wide leaves 2.7 cm long in control (A), 4.7 cm in kitchen waste water (B), and 6.7 cm in aquarium water (C) (Table 3; Fig. 5).

Brinjal showed increased growth in the aquarium water when compared to kitchen waste water and control (Fig. 7).

Chilli (*Capsicum annum* L.):

Chilli also has the most branches with shoot growth of 8.7 cm in control (A), 14.7 cm in kitchen waste water (B), and 31.7 cm in aquarium feed water (C) (Table 1; Fig. 3).

Furthermore, root growth was observed to be 1.0 cm in the control (A), 1.3 cm in the kitchen waste water (B), and 1.3 cm in the aquarium water (C) (Table 2; Fig. 4).

Chilli also grew significantly in outgrown leaves, with 8.7 cm in control (A), 11.7 cm in kitchen waste water (B), and 7.7 cm in aquarium water (C) (Table 3; Fig. 5).

The growth detected in kitchen waste water generated the highest growth result as compared to aquarium water and the control inChilli. (Fig. 8)

Greens: (*Amaranthus*):

Greens exhibited maximum number of branches with a healthy shoot growth of 12.7 cm in control (A), 14.7 cm in kitchen waste water (B), and 24.7cm in aquarium feed water C (Table 1; Fig. 3).

A rich growth of the root length was observed of 1.3 cm in control (A), 1.7cm in kitchen waste water (B), and 2.7cm in aquarium water (C) (Table 2; Fig. 4).

Likewise, the growth of Greens leaves were observed as 6.7 cm in control (A), 8.7 cm in kitchen waste water (B), and 19.7 cm in aquarium water (C) (Table 3; Fig. 5).

The following growth rate in Greens was observed to have an increased growth in aquarium water when compared to other water samples (Fig. 9).

Based on their development with kitchen waste water and aquarium water, the plants *Solanum melongena*, *Capsicum annuum*, *Impatiens balsamina*, and *Amaranthus* have exhibited varying results. They were discovered to have lasted the experiment and had developed in length of stem, number of leaves, and other characteristics. Balsam and brinjal plants grew significantly with kitchen waste water, whereas chilli and greens plants grew significantly with aquarium water. As a result, both positive alternatives for the control (tap water) emerge, indicating a reasonable germination rate and a lot of development but with different shoot lengths.

Discussion

The growth of decorative and vegetative plants is clearly influenced by water quality. The use of waste water for irrigation is a common occurrence. Due to the high nutritional content of waste water, it may be possible to reduce or even eliminate the need of artificial fertilisers. The use of sewage water for agricultural growth has been used in arid and semi-arid regions of the world for over a century. Large amounts of waste produced around the world can be used to establish a viable and essential source for certain industrial chemicals. Food and wastes such as kitchen, refuse/garbage, and swill are stored here. These are commonly defined as food products and solid wastes, which are generated as a result of food processing, cooking, distribution, or production and consumption. Kasiviswanathan *et al.* (2022) claimed that due to the inhibitory effect of high salinity of briny water simulant water on seed ger mination, they aimed to desalinate the simulant water. The simulant soil watered with briny water simulant, no turnip seeds germinated within 7 days of sowing, simultaneously, in our study the specific amount of saline content in both waters had less or minimal effect on the plant growth. The plant yield was noticed to be steady and healthy.

Luistal (2002) highlights some of the features, primarily related to farm irrigation management, such as the use of drip irrigation. The study of Luistal (2002) discusses some of the aspects, mainly relative on farm irrigation management including the use of treated waste water and saline water.

In our study, we subjected Kitchen waste water and aquarium water to study the germination, shoot length, and root length of balsam, brinjal, amaranthus, and chilli. The results obtained in comparison to plants fertilised with aquarium water, balsam and chilli plants fertilised with kitchen waste water grew faster. .

Wang *et al.* (2017) conducted a study in green house to evaluate the impact of replacing mineral fertilizer with organic fertilizers on soil fertility. They have studied growth of plants with the organic fertilizers. Our study has shown a similar observations. Balsam and chili plant fertilized with kitchen waste water showed better growth when compared to plants fertilized with aquarium water.

Similar results were obtained by Arakeline *et al.* (2018) who worked on composition of household organic waste and its effects on tomato plant. Hence, our study of utilizing the organic water as fertility booster support the observations of Arakeline *et al.* (2018).

Amaranthus and brinjal showed better growth response to germination, shoot length, root length and number of leaves to aquarium water. Several authors have reported the influence of organic fertilization on the mineral composition of tomato leaves (Mala *et al*., 2013).

Singh *et al.* (2004) used sewage water for irrigation of several crop plants including wheat, gram, palak, methi and berseem, The use of water for agricultural production in water scarcity region requires innovative and sustainable research and appropriate transfer of technologies. This study recorded the healthy growth of all plant crops which is in agreement with the report of Singh *et al.* (2004).

The impact of municipal solid waste composition application on the growth of lettuce and tomato plants growing in large 40 L pots was reported by Giannakis *et al.* (2014). The present study derives support from the observations of Giannakis *et al.* (2014) as we have also reported plant growth incorporating various home based water to increase the yield and the production of the plants.

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