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Organic Fermented Liquids, Eco-Friendly Approach For Sustainable Agriculture: A Review

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Abstract: *Indian agriculture, long rooted in traditional eco-friendly practices, now faces soil degradation, pollution, and declining productivity due to excessive chemical inputs. To restore sustainability, organic fermented liquids—such as Kunapajala, Jivamrit, Amritjal, and Panchgavya—are emerging as viable alternatives. These indigenous bioformulations enhance soil microbial activity, improve nutrient availability, and boost crop resilience, reducing dependency on external agrochemicals. Rooted in ancient Indian texts like Vrikshayurveda and Krishi Parashara, their use aligns with modern sustainable initiatives such as Bhartiya Prakritik Krishi Padhati. This review highlights the composition, preparation, and benefits of these organic fermented liquids, emphasizing their potential to rejuvenate soil health, support zero-budget natural farming, and promote sustainable agriculture.*
Keywords: *Organic farming, organic fermented liquid, kunapajala, jivamrit, amritjal*

INTRODUCTION:

Agriculture is the base of human life. India is an agriculture-dominated country. In the dynamic landscape of Indian agriculture, the pursuit of sustainability and enhanced farmer well-being has become imperative. With increasing use of fertilizer and pesticides in the Indian farming system, and at many places in a very imbalanced manner, environment has been harmed. Soils are getting acidic with low carbon content, ground water is getting polluted with high nitrate content, and air is accumulating more nitrous oxide. In many places, the soil is getting hard and unable to renew itself so that more and more chemical fertilizers are needed to grow crops, creating huge debts for the farmers. New pests and diseases, resistant to chemical pesticides, are appearing, as are unknown diseases and disorders affecting animals and human beings. Also the heightened demand for agricultural products has led to an increase in the cultivation of sandy soils, accompanied by a corresponding growth in knowledge about their potential for agricultural use (Donagemma *et al.*, 2016). As they are susceptible to nutrient loss due to their low cation-holding capacity, the use of inorganic fertilizers has limited benefits, making the benefits of increasing soil organic matter and soil health even more important (Zhao and Naeth, 2024).

In order to ensure sustainability in Indian agriculture, the government has been trying to promote Zero Budget Natural Farming (ZBNF), renamed as Bhartiya Prakritik Krishi Padhati (BPKP) (Bharucha *et al.*, 2020). BPKP is an organic agriculture practice, which refers to the zero cost of production of crops (zero external input system) that aimed at promoting traditional indigenous practices which gives freedom to farmers from externally purchased inputs. ZBNF guides the farmers towards sustainable farming practices thus helps in retaining soil fertility, to ensure a chemical free agriculture and ensure low cost of production and thereby enhancing the farmer's income.

Agriculturist & Padma Shri awardee Subhash Palekar, in the mid-1990s as an alternative to the Green Revolution's methods driven by chemical fertilizers and pesticides and intensive irrigation, promoted this concept. Government has been promoting organic farming under the dedicated scheme of Paramparagat Krishi Vikas Yojana (PKVY), which encourages all kinds of chemical-free farming systems including ZBNF. ZBNF is based on the principle that soil has all the nutrients required for the plants around its root zone but these cannot be absorbed by the plants easily. Microbes in the soil play an active role to achieve this. Microbes present in the rhizosphere produce various metabolites, bioactive com- pounds, enzymes, and phytohormones (i.e., cellulase, catalase, siderophores, and indole acetic acid), which not only enhance the microbial community but also promote plant growth and improve soil fertility (Reinhold *et al.*, 2015; Alam *et al.*, 2020). Natural organic formulations induce a multifold increase in

microbial population and earthworm activity, which enhances nutrient availability in soil, leading to improving the plant's resistance mechanism, and increases crop productivity (Ray *et al.*, 2020; Maduka *et al.*, 2019; Patel *et al.*, 2021). So, organic pesticides and organic fertilizers could be appropriate options to enhance the microbial activity in soil and increase the uptake of the nutrient by the plants. Plants depend on soil only for 1.5–2.5 percent of nutrients required for them and remaining amounts are taken from air, water and sunlight (Chore, 2016).

India is an ancient and one of the oldest forms of civilization with rich agricultural heritage since the time of Rigveda (Nene, 2007, 2012a; Prasad *et al.*, 2016). In India, agriculture occupies a special place in its economy as it supports majority of its population (about 60-70%) for their livelihoods. Agriculture in ancient and medieval India was considered sustainable because of the use of age-old and traditional farming practices considering them superior to the conventional agriculture science (Howard, 1943). Agriculture and animal husbandry in India developed in Indus and Sarasvati Valleys of Bharatvarsh (present India and Pakistan) over 6,000 years ago. However ancient treasure of literature like Vedas (Rigveda, Samaveda, Atharvved and Yajurveda), Vrikshayurveda (Surpala), Krishi Parashar (Rishi Parashara), Krishi sukta etc. described excellent, eco-friendly, sustainable agriculture practices. Sustainable farming also helps India to meet sustainable development goals (09 out of 17 SDGs, Fig 1).

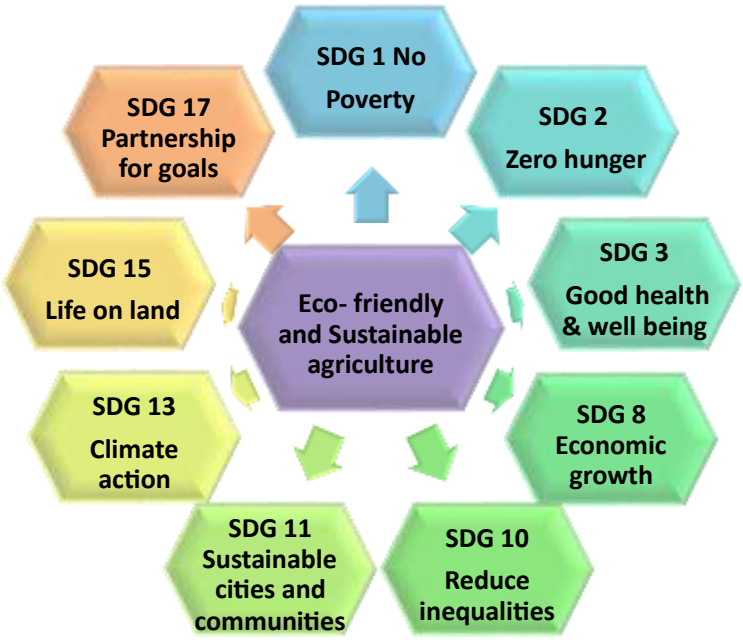


Figure 1: Eco- friendly and sustainable agriculture to meet SDGs

Organic agriculture mostly relies on application of organic manures, bio-pesticides, organic mulching etc. and adoption of eco-friendly practices. As organic agriculture is a traditional approach, other than these organic products and practices, various conventional organic formulations are also associated with it in the form of indigenous technical knowledge (ITK). These ITKs are variable with location, availability of raw materials and farmer's practice. According to Nene several methods of natural farming was used in ancient literature (Table 1) (Nene *et al.*, 2017).

Table 1: Organic agriculture practices used in traditional farming

S. No.	Method of farming	Concept	Key elements	First mention

1.	Natural way of farming/ Do nothing farming	Let nature play its role	Nature	Fukuoka (One Straw Revolution)
2.	Biodynamic agriculture (Pseudoscience and esoteric)	Holistic farming approach that views the farm as a living organism, emphasizing ecological balance and sustainability . Emphasis on spiritual and mystical perspectives	Crop rotation, composting with biodynamic preparations, and fostering a connection between the land and humanity	Rudolf Steiner (Steiner, 1924)
3.	Vermi-culture	process of cultivating earthworms, typically for the purpose of producing nutrient-rich organic fertilizer	Vermicompost, vermicast, vermiwash	Appelhof
4.	Natueco culture	emphasizes observing, understanding, and collaborating with nature using scientific principles to strengthen both the farm and its ecology	**Amrit mitti Amritjal** (nectary water) – variant of Kunapajala	Manikrao Dabholkar (2001)
5.	Zero budget Natural farming (ZBNF)	aims to eliminate the use of external inputs like fertilizers and pesticides, relying instead on natural processes and locally available resources. Thus, zero cost.	**Bijamrita** (organic liquid for seed treatment), **Jivamrita** (Microbial culture), **Achhadana** (mulching), and **Waaphasa** (soil aeration)	Subhash Palekar (2005)
6.	Rishi- Krishi	traditional Indian agricultural practice rooted in ancient Vedic principles and emphasizes natural, sustainable methods	**Angara** (Holy Ash), **Amrit Pani, Beej Sanskar** (Dressing of Seeds for planting) **Achhadana** (mulching)	Bhaskar Save / D. D. Deshpande (2005)
7.	Agnihotra krishi	an ancient Vedic practice that integrates fire rituals (Homas or Agnihotra) into organic farming methods	Use of Agnihotra ash water by performing specific fire ceremonies at sunrise and sunset using a copper pyramid, cow dung, ghee, and brown rice, while reciting specific mantras	Disciples of Gajanan Maharaj of Akkalkot Paranjape

8.	Panchkavya (Panchagavya)	A herbal mixture of five products from Cow	Cow's milk, Curd (Yogurt), Ghee, Cow's urine and Cow dung.	Natrajan (2003, 2008) Fukuoka (One Straw Revolution) Claude Alwares (The organic farming Source book)
9.	Kunapajala, Sasyagavya	Organic liquid fertilizer made by fermenting animal flesh and plant materials like grains, honey, oils etc.	Kunapajala- Animal flesh – fishes, rat etc.	Parashara, Kashyapa, Surapala (Majumdar, 1935)
			Sasyagavya (herbal Concoctions using various plants)	(Ayangarya, 2004)
10.	Compost tea	Liquid extraction of nutrients and microbes from finished compost with molasses	Finished compost or worm castings, molasses, kelp fertilizer, fish fertilizer	Earlt Roman, (Cato, 1933) Greek and Egyptian times (Ingham, 2005)
11.	Bokashi tea	Organic fertilizer fermented with organic waste, beneficial microbes, and sugar	Animal dung, rice bran, saw dust, husk ash	Early Edo period in Japan (Higa, 2015)
12.	Seaweed sap	Bio-stimulant derived from marine macroalgae; rich in trace minerals, growth hormones (cytokinins, auxins), and vitamins	Red and brown sea weeds	Traditionally used in coastal regions; commercialized in 20th century
13.	Aquaponics	Closed-loop system integrating aquaculture (fish farming) with hydroponics (soil-less plant cultivation); utilizes fish waste as plant nutrients	Fishes, beneficial nitrifying bacteria, plants to cultivate	Aztecs (Chinampas system), Modern revival in 1970s–1980s

Vrikshayurveda (Surapala) became famous by the efforts of Dr. Y. L. Nene (founder and chairman of Asian Agri-History foundation). The book was focused for soil health based on the principles of Ayurveda. The book emphasized the use of kunapajala for nourishment of soil. Similarly other literature like Krishi Parashara (Rishi Parashar), Vrikshayurveda (Surapala), Brihat Samhita (Varahamihir), Krishi-suktis, Sarangdhara paddhati (Sarangadhara) etc. are full of organic alternatives for chemical fertilizers, chemical pesticides, and seed treatment chemicals.

Traditional organic fertilizers include Kunapjala, Jivamrit, panchgavya etc. According to Nene (2018), Vrikshayurveda have the concept and practice of use of fermented liquid manure in India. Nene states India is the origin for using fermented liquid manure, additionally he stated that all fermented liquid manures are variants of Surapala's Kunapajala. Several variants of organic fermented manures are given below-

A. Kunapajala

Traditional Kunapajala is made from two words: Kunapa means smelling like corpse, and Jala means water. It is also known as Kunapambu which means fermented filth. This traditional liquid organic

manure made from urine, cow dung, honey, eggs, bone meal, rice husk and coconut cake (Table 2, Kavya and Ushakumari, 2023). Several modifications were made following the discovery (Biswas and Das, 2023).

Table 2: Composition of Kunapajala

S.No.	Raw material	Quantity	Processing
1.	Fish (*Sardinella longiceps*)	2 Kg	Boil till it becomes viscous and semi-solid, then transfer to plastic barrel Add following items
2.	Bone meal	1 Kg	
3.	Rice husk	1 Kg	
4.	Coconut oil cake	1 Kg	
5.	Sprouted black gram	500 gm	
6.	Water	10 liters	
7.	Cow dung	10 Kg	Close the lid of vessel. Left for 15 days at warm place. Stir in clock wise and anti-clock wise direction at regular intervals. Filter the content. Resultant filtrate is non- herbal kunapajala
8.	Cow urine	10 liters	
9.	Honey	250 gm	
10.	Ghee	250 gm	
11.	Jaggery	2 Kg	
12.	Milk	1 liter	
13.	Water	75 liters	

Ayangarya (2006a) prepared the kunapajala from sapharifish (*Chrysiptera cyanea*), mushika (rat) which are known as indsafari and mushika kunapa. Same time Narayanan (2006) reported the formulation of mushika kunapa (rat gunapa). Over the years, several modifications have been made in order to prepare Kunapajala.

B. Shasyagavya

The herbal version of Kunapajala is popularly known as Shasyagavya which is prepared by fermenting the mixture of cow dung, cow urine, weed or plant parts or vegetables wastes and water in 1:1:1:2 ratios, respectively.

Herbal kunapa was developed by Ayangarya (2005), which is also called Sasyagavya (Nene, 2017) (Table-3).

Table 3: Composition of herbal kunapa (Sasyagavya)

S.No.	Raw Material	Quantity

1.	Leaves of non-milky and non- grazing plants: *Adhathoda vasica*, *Vitex negundo*, *Azadirachta indica*, *Ocimum teneuiflorum*, *Clerodendrum infortunatum*, *Eupatorium odoratum*, *Cassia fistula*, *Glyricidia maculata*, *Mimusops elengi* and *Pongamia pinnata*	2 Kg of each plant. Leaves cut into small pieces. Mix with following ingredients.
2.	Cow dung	10 Kg
3.	Cow urine	15 Liter
4.	Sprouted black gram	2 Kg
5.	Jaggery	2 Kg
6.	Water	80 Liter

C. Amritjal

Amritjal (nectary water) is one of the important components of Natueco culture. Natueco word is formed by combining two words Natural and ecological (Dabholkar, 2001) (Table 4). **Table 4: Composition of Amritjal**

S.No.	Raw Material	Quantity
1.	Cow Urine	1 liter
2.	Cow dung (fresh)	1 Kg
3.	Jaggery	50 gms
4.	Water	10 liters

This mixture allowed to ferment for three days, meanwhile it is stirred twice or thrice daily. On fourth day, this concentrated suspension is ready for use. For the use, one part of concentrated suspension is mixed with 10 parts of water.

D. Jivamrita

Another organic fertilizer jivamrita is fermented microbial culture, like kunapjala of vrikshayurveda. It provides nourishment to soil, and act as catalyst for soil micro-organisms and earthworms. It also helps to prevent fungal and bacterial diseases of plants (Nene, 2017) (Table 5).

Table 5: Composition of Jivamrita

S.No.	Raw material	Quantity
1.	Fresh local cow dung	10 Kg
2.	Aged cow urine	5-10 litre
3.	Cane jaggery	2 Kg
4.	Pulse flour	2 Kg
5.	Virgin soil	A handful
6.	Water	200 liters

The mixture is fermented for 48 hours in a shady place. For one acre of soil 200 liters of jivamrita is sufficient. It can be applied two times for the crop, through water irrigation or as 10% foliar spray.

E. **Amrit Pani**

Amrit pani is another fertilizer and one of the main components of Rishi Krishi Deshpande (Table 6). Organic liquid bio-enhancer used in agriculture to improve soil health, boost crop growth and protect against pests.

Table 6: Amrit Pani composition (2lts)

S.No.	Raw material	Quantity
1.	Cow ghee (indigenous cow breed)	2.5 gms
2.	Honey/Jaggery	50 gms

3.	Fresh cow dung (Desi)	500 gms
4.	Water	2 liters

First of all, cow ghee and cow dung are mixed thoroughly, then honey is blended to this mixture an kept aside for 4 hours. At last, 2 liters of water is added to this mixture and stirred properly. Let it kept aside for 7 days under shade and strain it. Sometimes pulse flour and neem leaves were also added. For one acre of crop 200 liters of amrit pani is required.

F. Panchgavya

Formulation and applications of Panchagavya is well mentioned in Puranas. According to Natarajan (2008) panchagavya consists of five products of cow i.e. cow dung, cow urine, cow milk, cow curd, cow ghee; besides these jaggery, banana, tender coconut, and water. Natrajan claimed that this formulation of panchgavya gave the miraculous effect on treated crops (Table 7).

Table 7: Composition of Panchkavya/ Panchgavya

S.No.	Raw material	Quantity	Making Process
1.	Fresh cow dung	5 Kg	• Vessel- mud pot/ concrete tank/ Plastic cane. • Container fill with fresh cow dung and cow ghee, left it for 3 days and stir twice a day. • Rest ingredients were added on 4th day, stir twice daily. Liquid fertilizer will be ready in 15 days. • Author also suggested the substitutes for sugarcane juice and toddy.
2.	Cow urine	3 liters	
3.	Cow milk	2 liters	
4.	Cow ghee	½ Kg	
5.	Cow curd	2 liters	
6.	Sugarcane juice	3 liters	
7.	Tender coconut water	3 liters	
8.	Banana (ripe)	12 nos.	
9.	Toddy or grape juice	2 liters	
10.	Water	3 liters	

Generally, Panchagavya is recommended for all crops, as foliar spray at 3% level (3 liters stock solution in 100 liters of water), in irrigation water (50 litres for one hectare), as a dip for seed and planting materials, or before seed storage.

The liquid organics Panchagavya and Kunapajala, individually as well as in combination, proved their efficacy in promoting the growth and yield attributes of vegetables crops *Sarkar et al.*, 2019. The degree of efficiency of individual treatments varied, but Panchagavya & Kunapajala together were found to be best for enhanced utilization of leaf nitrogen, efficient photosynthetic activity, and improved yields.

G. Agnihotra Krishi (Homa Farming)

Agnihotra is a sanskrit word combining Agni means 'fire' and hotra means 'healing'. The most significant aspect of Agnihotra is that it combines the energies of five elements –sun, space, air, water and earth to produce subtle changes in the living organisms and helps to restore the bio-rhythm. The basic principle is 'you heal the atmosphere and the healed atmosphere will heal you'.

To prepare the agnihotra ash, start a few minutes before sunrise and sunset. Place a flat piece of cow dung cake at the bottom of copper pyramid with air space below. Apply a little cow ghee on a small cow dung cake and light it. Place it in the middle of the pyramid. When the whole piece catches fire take a few rice grains in the left palm and apply ghee to them. Start chanting small mantras adding SWAHA in the last and put the rice in the fire. Let it sit till the fire gets extinguished itself. Just before next Agnihotra collect the ash and keep it in a glass or earthen container. The highly energized ash can be used as organic fertilizer as well as purifying water (Table 8)

Table 8: Composition of Agnihotra ash water

S.No.	Raw material	Quantity	Making Process
1.	Cow urine	5 liters	

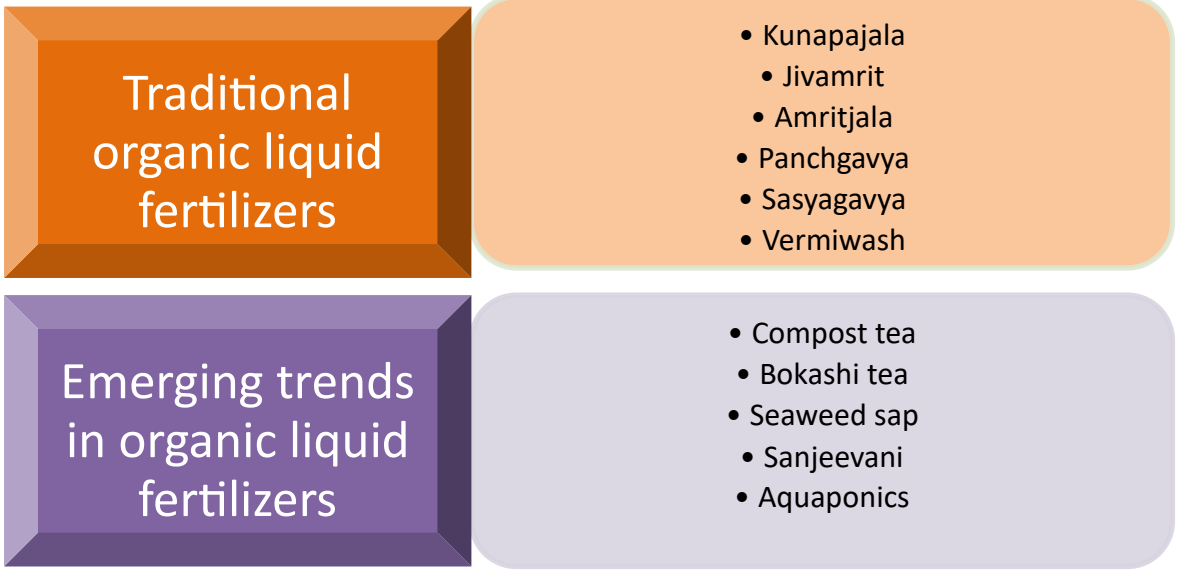
2.	Agnihotra (ash)	2 kgs	Combine cow's urine and agnihotra ash and put it in water tank. Let the mixture sit for 3 days. Without disturbing the settled ash, carefully decant and spray onto crops.
3.	Water	100 liters	

Scientific evidences proved the efficacy of these organic liquids in various crops. The study on Marigold revealed that the fertilizer significantly improved the growth and quality of flowers. The application of Jeevamrit enhanced the viable bacterial, fungal and actinomycetes counts (Kaushal et al., 2024). The application of Jeevamrit in broccoli enhanced the soil properties, resulting in better nutrient absorption and more yield (Dash et al., 2019). Chandrakala et al. (2008) suggested that organic fertilizers might increase nutrient availability in soil during the early stages of plant growth and release native soil nutrients at later stages. They also revealed an increase in the number of fruits per plant due to the presence of IAA, GA3, and other nutrients in fermented liquid manures, which improve the yield of plants. Yadav and his co-workers (2024) recorded the influence of jeevamrit and kunapajala on growth and yield of sweet basil Ocimum basilicum L. and found them better organic alternative for high yield of crop production. Kaushal and his colleagues demonstrated a significantly higher microbial load in the Jeevamrit compared to the chemical fertilizers, corroborating the positive impact of Jeevamrit application on soil microbiology. This aligns with previous studies where organic manure, similar in composition to Jeevamrit, exhibited significant improvements in the soil's physical and chemical properties, surpassing the efficacy of NPK treatments.

These findings suggest that the organic liquid formulation, i.e., Jeevamrit is effective in promoting optimum plant growth and development by increasing photosynthesis in plants (Singh and Lal, 2019). Among natural farming formulations, Jeevamrit is recognized as a pillar of natural farming systems (Bharadwaj, 2021). Jeevamrit application in the soil has the efficiency to improve soil fertility and plant development.

Formulation and applications of Panchagavya is well mentioned in Puranas. According to Natarajan (2008) panchagavya consists of five products of cow i.e. cow dung, cow urine, cow milk, cow curd, cow ghee; besides these jaggery, banana, tender coconut, and water. Natrajan claimed that this formulation of panchgavya gave the miraculous effect on treated crops. Mishra (2007) stated that Kunapajala has the ability to substitute chemical fertilizers to a high extent. The use of Agnihotra ash has been found to increase plant phosphorous solubility and availability (Kratz and Schnug, 2007). Being a highly porous material, it also enhances the aeration for root respiration and drainage, making nutrients readily available to plants (Pathak and Berk, 2015).

Natural farming systems increase plant immunity and disease resistance, resulting in 50% fewer mycotoxins in crops and resulting in increased shelf life (Siddique et al., 2014).



In perennial cropping systems, it has been demonstrated that roots and dissolved organic matter are fundamental for the long-term sustainability of soil organic matter at greater soil depths (Sokol et al., 2019; Spielvogel et al., 2014). Organic cultivation areas have expanded globally as an alternative to achieve sustainability (Lorenz and Lal, 2016). Many of the effects of the practices used in organic soil management still need to be better understood, especially in the long term (Rigolot and Quantin, 2022).

Although various studies have demonstrate the benefits of organic fertilizers in improving soil health, crop yield, and pest control, these studies are often limited in scope and geographical coverage. Addressing these gaps and to explore the full potential of organic liquid fertilizers rigorous scientific research and field trials is essential to validate organic manures as a viable and scalable solution for sustainable agriculture.

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