Viewpoint
ISSN (Print) : 0971-7730
Asian Agri-History, *Vol 22(1), 2018*
DOI: 10.17485/aah/2018/v22i1/18292

The Concept and Formulation of Kunapajala, the World's Oldest Fermented Liquid Organic Manure

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Abstract

Beginning in the 1990s, researchers and farm policy makers in India and the rest of the world focused their attention on 'organic farming' in order to better the sustainability of agriculture. I had earlier described and discussed most of the methods currently recommended in different parts of India[14]. These methods are: (i) The natural way of farming ('do-nothing') farming by Masanobu Fukuoka; (ii) Biodynamic agriculture by Rudolf Steiner – introduced in India; (iii) Vermiculture developed by Mary Appelhof– introduced in India; (iv) 'Natueco' culture by Shripad Dabholkar; (v) Zero-budget natural farming (ZBNF) by Subhash Palekar; (vi) *Rishi-Krishi* by Mohan Deshpande; (vii) *Agnihotra* by disciples of Gajanan Maharaj of Akkalkot, Maharashtra; (viii) *Panchagavya* by K. Natarajan; (ix) *Krishi-suktis* and *Vrikshayurvedas* (Surapala, Sarangadhara, and others) by sages and scholars of ancient and medieval India; (x) Compost tea by Elaine Ingham– introduced in India; and (xi) EM-Bokashi tea by TeruoHiga– introduced in India. Of these methods, Dabholkar's'Natueco', Palekar's ZBNF, Natarajan's panchagavya, Ingham's compost tea, and EM-Bokashi of Higa are related to *Kunapajala*, which is produced by adopting the liquid fermentation technology as documented by Surapala[16], in the first-ever compilation of the methods of Vrikshayurveda. Thus, *Kunapajala*, the ancient Indian fermented liquid manure, was a stupendous innovation. The fact of Kunapajala's Indian origin went un-noticed for centuries, which is why agronomists, all over the world, currently tend to believe that the innovation of fermented liquid manure was done by farmers in Japan, Korea, China, or even medieval Europe— but not by farmers of India.

Received: 28 Sep 2017, Accepted: 14 Nov 2017

1. Introduction

In the following paragraphs,I have attempted to share evidence to support my viewpoint that it was India that pioneered the innovation and use of fermented liquid manure almost 1000 years ago. Many historians and Indology scholars have a chronic habit of not accepting the dates given by Indian scholars from India. Surapala, in the colophon of his *Vrikshayurveda*, mentions that he was a physician [Ayurveda] in the court of King Bhimpala, son of Trilochanapala[16] of the Shah Pala dynasty, in a Hindu confederation, spreading from Gujarat to the Kanauj region, including the Shivalik Hills[20]. Bhimpala died in 1026 CE. It was common during those times to ask Ayurvedic physicians to develop gardens for kings and nobles, and maintain them.

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The first mention of *Vrikshayurveda* (VRK) is found in Kautilya's *Arthashastra*[10], but even by the time of Varahamihira [505–587 CE], who compiled the Brihat Samhita[4], the science of VRK was in its early stages. The first systematic text on VRK was written in Sanskrit by Surapala [c.1000 CE]. Its English translation was published for the first time by the Asian Agri-History Foundation [AAHF] in 1996[16]. Almost around the same time as VRK, the compendium *Lokopakara* [1025 CE] — with a chapter on Vrikshayurveda — was compiled in old Kannada by Chavundaraya in Kalyani, near present-day Bidar in northern Karnataka[3]. Subsequently, texts on VRK with titles such as Vishvavallabha and Upavanavinoda[17,18], and others were compiled.

2. Kunapajala

All VRK texts emphasized gardening, raising and managing herbs, flowers, fruits, and vegetables. Most recommended practices such as soil drenching, foliar sprinkling, seed dipping, etc. were similar to present-day methods. The most significant innovation, apparently a first in world agri-history, was the development of fermented liquid manures from organic wastes — Kunapajala [literally, 'filthy fluid'] or Kunapambu [fermented filth]. Surapala's procedure involved collecting and storing animal wastes as and when available. Although wastes from dead boar were mentioned first Surapala,[16] expanded the source of wastes to other animals, especially those with horns. The wastes were cooked and then stored after mixing with husk. When needed for use, sesame oil

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cake, honey, soaked black gram, and finally ghee (clarified butter) were added to the preparation.

The suggestion to store animal wastes underground [anaerobic?] was made possibly to contain the foul odor, as also to protect the materials from omnivorous scavengers. Surapala mentioned that wastes from other animals such as cows, porpoises, cats, deer, elephants, etc. can be used. In addition to these, animal skin was suggested by Chakrapani[17]. Kunapajala was prepared from virtually any animal waste and, therefore, gave flexibility to farmers in sourcing their materials. It is generally accepted that plant roots utilize chemical fertilizers faster than organic manures. This is true when the organic manures, which are soft and semi-dry, are scattered in the field. Application of Kunapajala was different from those of other organic manures. Kunapajala is a liquid and can quickly reach the rhizosphere when applied. Secondly, the ingredients of Kunapajala are fermented, which means the mass (proteins, fats, etc.) is already broken down into simple low-molec-

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ular-weight products; these would become available to the plant faster than in the case of traditionally applied organic matter[13]. It is only the farmers and sages of ancient India who took pains to formulate and use effective organic manure mainly for perennial plants. Application of diluted Kunapajala with sprayers is a modern innovation.

3. Panchagavya

According to Natarajan[12], the organic product *Panchagavya* (Sanskrit term; *pancha* = five, *gavya* = from cow) has the potential to play the role of promoting growth and providing immunity in the plant system. The Panchagavya formulation proposed by Natarajan consists of nine products: cow dung, cow urine, cow milk, curd and ghee (prepared from cow milk), cane jaggery, banana, tender coconut water, and plain water. When suitably mixed and used, Natarajan claims "miraculous" effects on treated crops.

The following items are added in steps, and mixed and fermented in a large container for 30 days: cow dung (7 kg); cow urine (10 liters); cow milk (3 liters); cow curd (2 liters); cow ghee (1 kg);cane jaggery (3 kg); tender coconut water (3 liters); and plain water (10 liters). The mixture is stirred thoroughly and allowed to ferment. This is called the "stock solution". Natarajan insists on products from Indian breeds of cow, and suggests that products from buffaloes are avoided. The reasons are unclear.

Species of Azotobacter, Azospirillum, Pseudomonas, Rhizobium, and phosphate solubilizing bacteria (PSB), have been detected in Kunapajala. In addition, substantial amounts of total organic carbon, gibberellic acid (GA), and indole acetic acid (IAA) were also found[1].

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.

Panchagavya has gained popularity with farmers in several states of India, especially in southern India. Panchagavya has excellent potential to contribute to food security in India.

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.,[19]. 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. In modern-day farming, with increase in organic inputs in high-value vegetable crops, the use of such growth promoters through soil drenching should be an efficient and economically better choice for the farming community. At the same time, Panchagavya + Kunapajala can be used as a prophylactic measure against disease incidence in vegetable crops. The Kunapajala described by Surapala contains

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flesh unlike Panchagavya. Therefore, no wonder the combined use of Panchagavya and Kunapajala gave better results than either of them[19]. Panchagavya has more quantity of milk products, while Kunapajala has flesh and marrow. Thus, the synergistic effect! Kunapajala can be beneficial to the growth of medicinal plants with apparently no toxic effects on humans when compared with chemical fertilizers. Reports reveal that Kunapajala application gives phenomenal effects on yield and quality. The Kunapajala preparation and application techniques need to be researched further[5].

4. Compost Tea

It is claimed by Brehaut[6] that methods for brewing compost teas date back to early Roman, Greek and Egyptian times. Names of Cato the Elder (234 BCE–149 BCE) and Pliny the Elder (23–79 CE) have been mentioned as the documenters [Ingham, 2005][9]. My own search revealed that Palladius [400–500 CE] in Book 4 had suggested a remedy for curing sick grapes: "Pour wine, or oak ashes in vinegar on sick roots. Apply goat and sheep dung to an injured grapevine; but if the roots are affected, use liquid manure."[15]. There is no reference to fermentation relating to "liquid manure". And no further details are available in the literature for verification of this 'history'.

Compost tea has received a boost since the late 1990s; this specific term and technique was developed by Dr. Elaine Ingham, a well-known soil scientist. The use of compost tea has become popular with farmers in the West. It is a liquid extraction of nutrients and microorganisms from finished [fermented] compost that is used as a foliar spray or for soil amendments. Compost tea can be made by leaching the nutrients and microorganisms with aeration. Often, other supplements are added during the steeping process to aid in the proliferation of the beneficial microorganisms and bacteria. Molasses are added as a food source for feeding the bacteria.

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There are two different, but not mutually exclusive, ways of applying compost tea: as a soil drench, or as a foliar spray[8].

1) Foliar applications: (i) apply beneficial organisms to plant aboveground surfaces, so disease-causing organisms cannot find infection sites or food resources (i.e., probiotic approach); (ii) provide nutrients as a foliar feed.

2) Soil applications: (i) help develop the biological barrier around roots (i.e., probiotic approach); (ii) provide nutrients for roots to improve plant growth; (iii) improve life in the soil in general, with effects on soil structure, water holding, root depth; and (iv) improve nutrient cycling, nutrient retention and disease-suppressiveness. Thus, the composting occurs due to fermentation and the "tea" extracted from such compost is a fermented liquid manure like Kunapajala.

5. Bokashi Tea

Dr. Teruo Higa, a horticultural professor at the University of Ryukyus in Okinawa, Japan, developed (around 1982) a technology using Effective

Enhanced with probiotic technology and utilizing the power of all-natural beneficial microorganisms, Bokashi expedites the composting process by fermenting food waste. Complete breakdown of the waste will occur, after it has been transferred to the soil, in approximately two weeks depending on the climate and soil conditions[11].

The spigot option is recommended for those with experience and/or for those who wish to take advantage of the fermented food waste (FFW) juice. The FFW juice can be used as a liquid fertilizer (1:5000 in water; 2–5 drops per quart of water) when watering plants. This procedure is similar to that of Kunapajala.

Microorganisms [EM], which is also called Bokashi composting (*bokashi* in Japanese is 'fermented organic matter'). From there, Higa refined the technology and learned its far-reaching implications. It is claimed that Bokashi composting originated in the Far East, with many researchers specifying the early Edo period (1603 and 1868) in Japan. No reference to support that the Japanese farmers were using crude Bokashi composting has been provided.

Enhanced with probiotic technology and utilizing the power of all-natural beneficial microorganisms, Bokashi expedites the composting process by fermenting food waste. Complete breakdown of the waste will occur, after it has been transferred to the soil, in approximately two weeks depending on the climate and soil conditions. The use of EM in Bokashi composting is an anaerobic process that relies on inoculated bran to fermented kitchen waste, including meat and dairy. It is a safe soil builder and nutrient-rich tea. The inoculum is a consortium culture of different 'effective' microbes commonly occurring in nature. Most important among them are: N2-fixers, P-solubilizers, photosynthetic microorganisms, lactic acid bacteria, yeasts, plant growth promoting rhizobacteria, and various fungi and actinomycetes. In this consortium, each microorganism has its own beneficial role in nutrient cycling, plant protection and soil health and fertility enrichment[2,11,22]

Organic fertilizer that was inoculated and fermented with a microbial inoculant (EM) contained large populations of propagated *Lactobacillus* spp., actinomycetes, photosynthetic bacteria, and yeasts; high concentrations of organic acids and amino acids (intermediate compounds); 0.1% of mineral nitrogen mainly in the ammonium (NH4 +) form, and 1.0% of available phosphorus; and a C:N ratio of 10[23].

The EM inoculation to both Bokashi and chicken manure increased fruit yield of tomato plants. Concentrations of sugars and organic acids were higher in fruit of plants manured with Bokashi than in fruit of other treatments. Vitamin C concentration was higher in fruit from chicken manure and Bokashi plots than in those from chemical fertilizer plots. Both fruit quality and yield could be significantly increased by EM inoculation to the organic manures and application directly to the soil.

In the fermentation process, the microbes will release the nutrients from the food waste making them not only available, but also absorbable by the plants (bioavailability). The microbe-rich Bokashi bucket will also produce antioxidants and organic acids (helps preserve the food waste and deal with pathogens), as well as produce a wide variety of enzymes to help break down the fibers, cellulose, lignin, chitin, etc. (Bokashi fermentation starter for recycling food). [*wastesustainablejc.org, recyclefood-*

waste.org]. The spigot option is recommended for those with experience and/or for those who wish to take advantage of the fermented food waste (FFW) juice. The FFW juice can be used as a liquid fertilizer (1:5000 in water; 2–5 drops per quart of water) when watering plants. This procedure is similar to that of Kunapajala.

The use of Effective Microorganisms is certainly a technology that deserves considerable and serious attention. Its beneficial potential for creating a sustainable world is too promising to be ignored[7] An argument has been raised by "eco-purists" that the introduction of EM into soils alters the natural chemical composition of the soils, displacing native microorganisms and nutrients, which may be harmful to the survival of native plant species[21]. This may be true, and more research is required on soil structure at local levels.

Some products have been formulated in India. As mentioned above, in Dabholkar's'Natueco' culture, the nutrients are provided through the application of *Amrut-Jal*;Palekar's Zero Budget Natural Farming applies *Jeevamrut*; and Deshpande's Rishi-Krishi mentions *Amrit-Pani*. All the three formulations use cow products, cane jaggery, honey, virgin soil, in different combinations and are allowed to ferment for varied durations[14].

6. Concluding Remarks

All the information given above points to the fact that fermented liquid is rich in nutrients and in useful microbe populations. All the four products — Panchagavya, Amrit-Jal, Jeevamrut, and Amrit-Pani — formulated between 1965 through 2010, and used in India, are obtained through fermentation and are frequently used as liquids. Similarly, Compost tea and Bokashi compost-tea are the results of fermentation. The liquid fermentation technique for making nutrients easily available to plants is the common key process in all the products discussed above. It is alleged that the Bokashi compost tea (crude form) was used by farmers of ancient Japan, Korea, or China, and similarly, that the Compost tea was used by farmers of France or Italy. The scientists who made the claim that farmers of ancient Europe or of the Far East thought of using manures based on fermentation process ignored, advertently or inadvertently, the pioneering efforts of ancient Indian farmers. Surapala's document, the *Vrikshayurveda*, provides firm evidence that the concept and practice of using fermented liquid manure originated first in India. Also, liquid fertilizers developed all over the world since 1960s, including, Panchagavya and Bokashi compost tea, can be considered *variants of Kunapajala* in my opinion.

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