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S&T REVIEW

APPLICATION OF PANCHAGAVYA IN AGRICULTURE: PRACTICES AND BENEFITS

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ABSTRACT

Panchagavya is an organic formulation from cow products and probably the greatest strength of traditional agriculture. This paper draws a review on its application, efficacy, and advantages against the backdrop of chemical fertilizers. The uses of panchagavya in agriculture are varied, such as in seed treatment, foliar spray, and soil application. The nutrient-rich composition of Panchagavya promotes plant growth, enhances fertility of the soil, and improves the microbial population in the soil, ultimately leading to sustainable agriculture. Studies indicate that crops treated with Panchagavya have yields either at par or even higher than those treated with chemical fertilizers, coupled with an improved health of its soil and reduced environmental impact. Cost analysis indicates that Panchagavya is cheaper in that it can be prepared on-farm with locally available materials, whereas chemical fertilizers are purchased and transported expensively. Panchagavya ensures minimal soil and water pollution, unlike chemical fertilizers, which have acidified, salinized, and contaminated the soil. Notwithstanding these advantages, it still has disadvantage regarding standardization and labor-intensive preparation procedures. This review concludes that Panchagavya has immense potential for sustainable agriculture; it is hoped that this organic fertilizer can offer a feasible and eco-friendly solution to chemical fertilizers and hence provide support to the global trend in organic farming and conservation of the environment.

KEYWORDS

Cost effective, Organic farming, Panchagavya, Soil health, Sustainable agriculture

1. INTRODUCTION

Panchagavya is an organic mixture made from five cow products: milk, ghee, curd, dung, and urine. Each product is referred to as "Gavya" in Sanskrit, and they are collectively known as Panchagavya (Ram, 2017a). Panchagavya is a combining of five cow products and a few additional ingredients. It improves the growth of plants and their ability to resist diseases, making it a valuable asset in organic agriculture (Raghavendra et al., 2014). Panchagavya, also known as Cowpathy, has a tradition in ancient Indian rituals and has been used in the Indian medical system, Ayurveda. It has religious significance for Hindus and is used as both fertilizer and insecticide in agriculture. It is widely recommended for organic farming and encourages environmentally friendly agricultural methods (Sangeetha and Thevanathan, 2010). Panchagavya provides numerous benefits to agriculture and organic farming, including natural, high-quality manure and biopesticides. It is derived from cow urine and manure, which improve soil nutrients, increase fertility, and ensure chemical-free food. These byproducts also serve as environmentally benign energy sources, producing biogas, gasoline, and power (Dhama et al., 2005).

Pesticides are substance used in the management of pests including insects, fungi, weeds, rodents, mollusk's and nematodes (Bernardes et al., 2015). Pesticides are widely recognized as essential to agricultural development because they reduce crop losses and improve food yield. Pesticides help farmers and consumers by protecting plants from pests, making food cheaper (Fenik et al., 2011). Pesticide production has increased by 11% year worldwide. Hence, from 1950 to 2000, this increased from 0.2 million ton to nearly 5 million tons. This rapid growth indicates an increasing dependence on pesticides in agriculture (Garcia et al., 2012). Overuse of pesticides has led to the emergence of health risks and pollution, the eradication of natural predators and parasites, and the development of resistance in plant diseases (Brimner and Boland, 2003). We need to develop and implement ecofriendly plant protection strategies such as organic amendments and animal byproducts like Panchagavya,

cow urine, fermented buttermilk, vermiwash, and bio sol. The use of conventional organic inputs is described in ancient sources such as the Vedas, Puranas, and Arthashastra (Nene, 2003). Organic farming and integrated pest management (IPM) were developed as a result of growing awareness of the negative effects that continuous pesticide use on human health and the environment (Rakesh et al., 2017). Conventional agriculture has affected soil and plant health, creating an intense need for organic farming to cope with these challenges. Organic farming has recently grown in favor as a means of sustaining crop production, maintaining soil nutrients, and ensuring environmental safety (Malligawad and Parameshwarappa, 2006).

Panchagavya act as a bio promotor. It functions mostly as a growth stimulant (75%) and partially as an immune booster (25%), making it an essential component of organic farming without affecting crop yields (Vedivel, 2007). Panchagavya supplies of N, P, K, and micronutrients, as well as plant growth regulators such as IAA and GA, for plant growth. It also provides organic nutrients and helpful microbes such as yeast, azotobacter, phosphobacteria, and lactobacillus, which benefit plants (Panchal et al., 2017). It also contains total-lowering sugars like as glucose. In addition, it contains chemolithotrophs and autotrophic nitrifiers (ammonia- and nitrite-oxidizing bacteria) that colonize the leaves, increasing ammonia intake and improving overall nitrogen supply to plants (Prabhu, 2009). Panchagavya promotes soil health and fertility, protects against pests and diseases, and increases crop quality and production without the use of chemicals. It is ecologically friendly and economical to prepare, and reduces cultivation costs by eliminating the need for fertilizers, pesticides, fungicides, and growth regulators (Kumar et al., 2019). Panchagavya is especially effective at treating seeds and seedlings, in addition to increasing plant growth and agricultural yield. It also accelerates the decomposition of organic manure (Thimmaiah, 2010). Panchagavya not only useful for agriculture but helps human and animal health as well as in economy. Researchers can investigate possible medical benefits of it (Sachithanandam and Muniyandi, 2021).

This review focuses on panchagavya diverse applications in agriculture. It shows how panchagavya improves soil quality, plant growth, and output. Additionally, it evaluates the organic input's economic profitability in comparison to panchagavya return. The study also contrasts individual ingredients and various Panchagavya preparation techniques. Furthermore, it discusses the potential health benefits of Panchagavya for both humans and animals, emphasizing its adaptability in addition to its agronomic applications.

2. PREPARATION OF PANCHAGAVYA

Ingredients used for preparation of Panchagavya are,

- Cow milk-2 liters
- Cow curd-2 liters
- Cow ghee-1 kg
- Cow urine-3litre
- Cow dung-5kg
- Jaggery- 1 Kg in 3 liters of water

- Tender coconut water-3 liters
- Ripened banana-12 Nos.
- Sugarcane juice - 3 lit
- Yeast - 100 gm

Sugarcane juice and coconut water are used to accelerate the fermentation which also help in minimizing the bad odor.

2.1 Method for preparation of Panchagavya

To prepare Panchagavya, mix 5-kilogram cow dung and 1 kg cow ghee in a mud pot and cover with a cloth for 3 days. Pour in 3 liters of cow urine and 3 liters of water on the fourth day, and stir the mixture twice a day for the next 12 days. Next, add 2 liters of cow milk, 2 liters of cow curd, 1kg of jaggery dissolved in 3 liters of water, 3 liters of soft coconut water, and 12 ripe bananas. For the next fifteen days, stir the mixture twice a day. However, if you want to maximize fermentation and reduce odor, add up to 100g of yeast. As a result, it will take roughly 30 days for the Panchagavya to become effective (Ponmanickam, 2023; Ram, 2017a). method of panchagavya preparation figure 1.

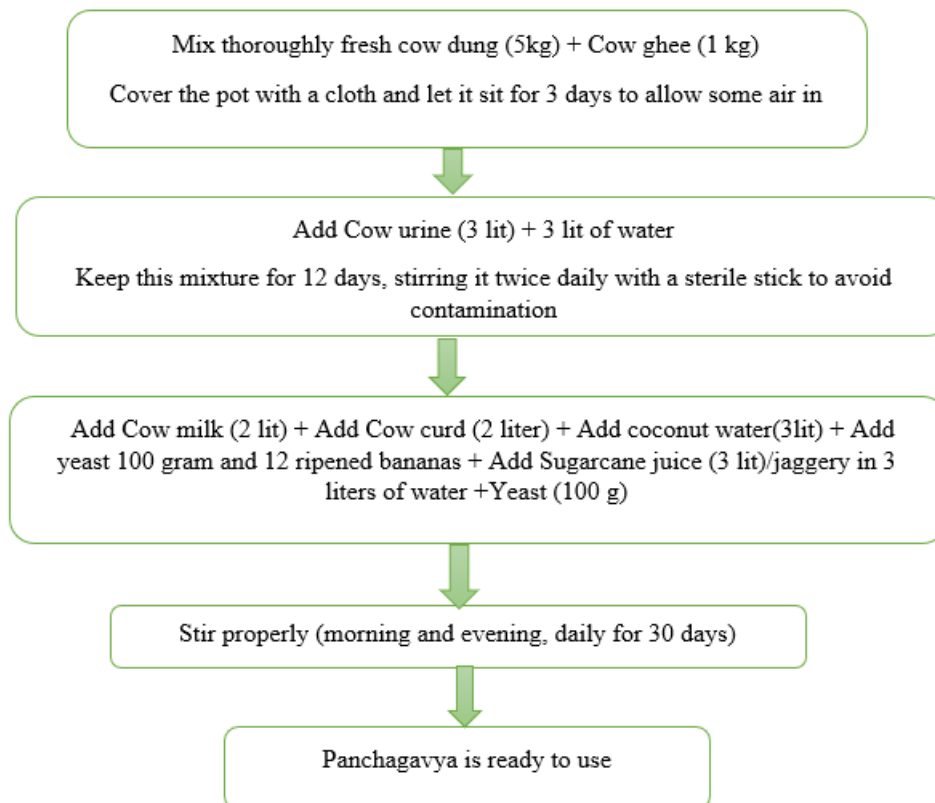


Figure 1: Method of preparation of Panchagavya

3. APPLICATION PRACTICE OF PANCHAGAVYA

3.1 Seed/seedling treatment

Seeds or seedlings can be soaked in a 3% Panchagavya solution before planting. Let it soak for twenty minutes, minimum. Soak rhizomes, such as ginger and turmeric, and sugarcane set s for 30 minutes prior to planting (Dambale, 2022).

3.2 Spray system

In comparison to other concentrations, a 3% Panchagavya solution is the most efficient. For all crops, mix three liters of Panchagavya with one hundred liters of water. We should use 300 ml of Panchagavya per tank for 10-liter power sprayers. Use a nozzle with a bigger pore size for hand-operated sprayers and filter out sediments when using a power sprayer (Raghavendra et al., 2014).

3.3 Flow system

Panchagavya solution can be incorporated into irrigation systems, either drip or flow, at a rate of 48-52 liters per hectare, increasing its effectiveness in agricultural applications (Dambale, 2022; Raghavendra et

al., 2014).

3.4 Storage of seeds

In this process, 3% of Panchagavya solution should be used to dip the seeds before drying and storing them for long shelf life, vigor and more percentage of germination (Navsare, n.d.).

Panchagavya is typically applied at different phases of plant growth: once every 15 days during the pre-flowering phase, every 8-10 days during the flowering and pod-setting stages, and once more during fruit or pod (Raghavendra et al., 2014).

4. PANCHAGAVYA VS. CHEMICAL FERTILIZERS: A COMPARISON

To examine the cost-effectiveness and environmental impact of panchagavya and chemical fertilizer, it is essential due to its eco-friendliness. A panchagavya is an organic mixture. While synthetic chemicals are linked to rapid nutrient availability and increased crop yield, they also have higher costs and potential environmental hazards. The basic comparison between panchagavya and chemical fertilizer is given in Table 1.

Table 1: Comparative Analysis of Panchagavya and Chemical Fertilizers

Aspect	Panchagavya	Chemical fertilizer	References
Nutrient availability	Slow-release, improves with time.	Immediate availability and quick results.	(Veeral and Abirami, 2021)
Crop yield	Comparable yields with organic practices.	High yields with increased use.	(Sutar et al., 2019)
Soil health	Improves the structure and microbial population of soil. Enhance soil health.	Can deteriorate soil quality over time. Lead to acidification or salinization.	(Patel et al., 2018)
Cost	Low cost made from local resources available in farm.	High cost requires purchase transport and continuous application.	(Mohan and Srinivasan, 2008)
Pollution risk	minimum, due to organic composition.	Risk of soil water and air contamination.	(Praburaman et al., 2015)

5. BENEFITS OF PANCHAGAVYA

There are many benefits that are accruing from Panchagavya especially in the context of the production of Organic farming. Organic manure referred to here is quite simple to prepare at home and does not require professional skills to prepare. Due to its low cost of production and ability to enhance the efficiency of lowering chemical fertilizers used by farmers, it is economical (Kumar et al., 2020). Besides, due to the presence of Antibodies Panchagavya is effective in controlling many diseases in plants and animals naturally.

5.1 Nutrient supply

Panchagavya has the totality of all macro and micronutrients and growth hormones like Indole Acetic Acid and Gibberellic Acid. These nutrients and hormones are quickly accessible to plants which support their proper growth and development (Golakiya et al., 2019). It has nitrogen, phosphorous, potassium and other micronutrients which include zinc copper and manganese, which are very vital in plant physiological processes. A study shows an effective rooting pattern in plants treated with Panchagavya which means that the plant can spread its root system at great depths to allow maximum absorption of nutrients and water from the soil. Such developed root systems also assist the plants to persevere during periods of drought thus increasing their drought resistance (Chaudhari et al., 2023). This balanced nutrient guarantees that plants get all the requisite constituents for their flourishing and growth (Singh et al., 2024).

5.2 Growth promotion

Constituents of Panchagavya include growth regulators such as hormones, enzymes, vitamins, amino acids and organic carbon (Behera et al., 2024a). These components control the growth and development of the plant and this results in improved vigour and productivity. Researchers revealed that the bio agents under the study of foliar application of Panchagavya and plant leaf extracts positively improved the growth of cumin, yield per seed, and the yield parameters of the plant (Mahajan et al., 2012). Panchagavya and manures play a very important role in increasing the plant height, number of branches and leaves, nutrient content and nutrient uptake, total dry matter accumulation and quality of crop. The efficient microorganisms in Panchagavya in the rhizosphere area have positive effects on plant development and crop yield, probably because of the presence of growth-promoting enzymes in Panchagavya which enhances cell division and multiplication (Shanmugam et al., 2008).

5.3 Pest and disease management

Panchagavya proves highly useful in terms of minimizing diseases and insect incidences, proving a natural source of pest control (Maity et al., 2020). It has moderate efficacy for controlling pathogens that are destructive to crops and its bioactive compounds enhance plant pest resistance thus healthier crops. This results in increased resistance to many pests and diseases that minimize the use of chemicals and pesticides. Cattle dung and urine in Panchagavya enhance plant immunity, providing resistance against pests and diseases (Sharma, 2020). The compounds that microorganisms generate for example organic acids, hydrogen peroxide and antibiotics are efficient to control and kill different pathogens (Ram, 2017b).

5.4 Soil health enhancement

Panchagavya improves soil health by improving its physical, chemical, and biological properties, leading to enhanced soil fertility and increased crop

productivity (Nekar, 2024a). Panchagavya enhances soil fertility by boosting organic matter and nutrient levels, improving nutrient uptake in plants, and promoting microbial growth and reproduction. It also improves soil health by increasing porosity, stabilizing soil aggregates, and regulating soil pH and nutrient profile (Bajaj et al., 2022a). During the fermentation process, various beneficial microorganisms proliferate. These microorganisms contribute to the breakdown of organic matter, releasing essential nutrients that improve soil structure and nutrient availability and hence plant health (Singh et al., 2023). Increases the population and activity of beneficial soil microorganisms, promoting nutrient cycling and organic matter decomposition (Jain et al., 2013).

5.5 Yield improvement

Various research and experiments have proved that the use of Panchagavya yields desired positive results in enhancing the productivity of crops (Sarma and Talukdar, 2024a). The Panchagavya-treated soil generally contained higher amounts of micronutrients like Zn, Cu, and Mn compared with FYM and vermicompost-treated soil and more bacterial and fungal counts too (Jain et al., 2013). This in turn improves the absorption of nutrients, root growth and vigor of plants in the field. Its application provides positive impacts to the health of the soil; enhancing the features of the soil and the nature of growth and yield of crops (Behera et al., 2024a). Using Panchagavya enhances flowering and fruit setting in plants. Panchagavya spray is beneficial in making flowers set in the plants and also induces fruit drops. This enhances the number of flowers produced, the capacity to produce more fruits, thus boosting the yields (K. Singh et al., 2024).

5.6 Environmental benefits

Fertilizer made from chemicals leads to the destruction of soil structure, microbial populations and pollution of the environment which affects soil health and productivity. Panchagavya is a viable solution for organic farming, thus it maintains the fertility of the soil as well as reduces the degree of harm caused to the environment (Pal and Patel, 2020). Panchagavya in agriculture renders a positive impact on the environment by eradicating the usage of chemical fertilizers and pesticides which are injurious to the environment and consequently decreasing the water and soil pollution (Nekar, 2024a). This is because constituents like cow dung and cow urine boost the insecticidal properties of the Panchagavya thereby lowering the utilization of risky chemicals on crops (Sharma, 2020).

5.7 Economic benefits

Panchagavya in agriculture is economically very beneficial to the farmers as it helps them to increase the productivity of their farms. In that regard, by replacing the expensive synthetic fertilizers and Chemical pesticides, it minimizes production costs. Since Panchagavya is made up of easily available and cheap natural inputs, it is relatively cheaper to prepare (Kumar and Singh, 2021). Further, it improves the nutrient status of the soil and the plants, thus increasing production and quality of the produce which is liked by the consumers and can command high prices in the market. The improved soil fertility and the minimized application of chemical also added to sustainability and resulted in less expenses in production (Ram, 2017b).

6. CHALLENGES AND LIMITATION

6.1 Standardization and quality control

The Panchagavya which is available in the market may deviate from the

traditional formulation in respect of its composition but there are no scientific methods developed to confirm or deny the formulation claims. Due to the complexity of the Panchagavya preparation process and the lack of a standardized reliable method to test the validity of the formulations, the various formulations in the market present a potential problem for farmers and researchers concerning the formulation's effectiveness (Maji et al., 2023).

6.2 Long preparation time

Preparing Panchagavya may take more than 30 days and thus consume much time in the processes (Chandra et al., 2019). Bio-Manures like Panchagavya are hence unappealing to farmers as they wish to work with products, that bring them instant positive returns rather than using slow-release fertilizers like this one. However, it has the disadvantage of taking longer to prepare and the effects also take time to experience which may not be suitable for farmers who are used to receiving quick results as offered by chemical fertilizers (Rijal et al., 2021).

6.3 Limited availability and location-specific nature of raw materials

Since Panchagavya is produced from cow raw materials, it is difficult to get it in places where cows are not reared such as urban and industrial areas. Availability of some of the raw materials also depends upon the season; for example, collection of cow dung and urine is also a little problem during the rainy season and as far as the supply of milk, curd, and ghee is concerned then they also have variations during different periods of the year. These challenges make it difficult to consistently prepare and use Panchagavya (Behera et al., 2024b).

6.4 Shelf life and storage

Fermentation time does have a direct effect on the biological activity of the Panchagavya samples besides affecting the composition of microbes present in them. This therefore indicates that with longer fermentation periods there is an alteration in microbial characteristics as well as their metabolic processes, which consequently influences the efficiency and characteristics of the Panchagavya (Gajera et al., 2024). Storage of Panchagavya is difficult and must be done to preserve the valuable mixture for use later on. This will ensure the time taken for its degradation and also prevents insects from acting on it as a breeding ground (Sharma et al., 2019).

6.5 Preparation process

The preparation of Panchagavya by the conventional process is lengthy, requires a large amount of manpower, and has a repulsive smell. Furthermore, it may sometimes fail to consider certain physical characteristics like moisture content or even the pH of the product making it almost impossible to standardize on the kind of product being manufactured (V. and J., 2022).

6.6 Scientific validation

This is especially challenging for ancient formulations such as Panchagavya to be proven scientifically before acceptance in the current methods of farming. The effectiveness is to be further confirmed, ways of making it more potent are to be discovered, and standard preparation guidelines are to be set (Semwal et al., 2024).

7. FUTURE PROSPECTS

There are these emerging factors; Economic reform, increased urbanization and declining labor force in the agricultural sector, are shifting and transforming this sector from the traditional subsistence monoculture to more commercial complex one (Pingali, 1997). This has enhanced the high utilization of agrochemicals which in turn; impacted the fertility of the soils, water, and quality of food produced. Therefore, in order to counteract the impact, people require sensitization on the preservation of organically grown crops (Kumar, 2022). Due to this, consumers have started demanding food free of dangerous chemicals and farmers are therefore in the lookout for eco-friendly measures. Currently, one-third of global soils are experiencing moderate to severe degradation due to factors such as soil erosion, nutrient depletion, salinity, sealing, and contamination (Naresh et al., 2018). On the same note the effects on the environment, organic products such as Panchagavya are environmentally friendly, they do not harm the environment instead they assist the soil and the plants without negatively affecting the environment (Ram, 2017c).

The beneficial microorganisms found in Panchagavya improve agricultural sustainability by enhancing plant growth and crop yield. Once established in the soil, these microbes support nutrient cycling, soil structure, and plant health, leading to a more productive and resilient

farming system (Beaulah, 2001). It has all the major and minor elements, all the hormones IAA, and GA which are essential for the growth and development of plants. Such nutrients and hormones aid in root formation, enhance resistance to dry periods and increase the general vigor of the plant (Sarma and Talukdar, 2024b). Besides, Panchagavya stimulates growth by providing growth-controlling factors, enzymes, vitamins, amino acids, and organic carbon and enhancing plant vigor and yield (Rai and Sarkar, 2022). It also has properties that act as pesticide and diseases control without the use of chemical fertilizers that would guarantee healthy crops and minimum damage to the environment (Selvaraj et al., 2021). Possible yield enhancements such as better flowering, fruiting, and total produce assure agriculture improvement benefits of the substance (Kumar and Singh, 2020). Additionally, Panchagavya's environmental benefits, such as reduced soil and water pollution and improved ecological balance, align with the global push towards sustainable and eco-friendly farming practices. Economically, Panchagavya offers cost-effective alternatives to expensive synthetic fertilizers and pesticides, making it a valuable tool for farmers to increase productivity while reducing production costs (Bajaj et al., 2022b).

Even though panchagavya has many benefits, the current research suggests that the benefits are influenced by the type of crop, type of soil, and the method of applying the product. This shows that there is a need for other research to be conducted to determine the exact effects that can be ascribed to the practice and how best it may be applied in various agricultural settings (Nekar, 2024b). Panchagavya's effects should extend beyond ancient literature, requiring scientific research to validate its biological activities and safety. Establishing clear standards and guidelines through rigorous studies will ensure its reliable integration into modern agriculture (Khangarot and Choudhary, 2023).

8. CONCLUSION

Panchagavya is environmentally friendly and considered an alternate to many inorganic chemicals, having several advantages regarding productivity, agricultural production, soil health, and the environment. It is simple and inexpensive to produce, which is a great tool for small-scale farmers. In addition to that, it seemed to increase development and, on the other hand, disease and pest resistance in plants, which marked its potential in organic farming. Its appeal can be increased further by refining the problems related to lead time and homogeneity. Panchagavya offers a viable route toward sustainable agriculture and environmental amelioration of the ill effects associated with conventional farming practices.

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