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Temporal Dynamics of Physical, Chemical and Biological Properties of a New *Panchagavya* During Preparation and Storage stage

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ABSTRACT

Panchagavya is a traditional liquid formulation which has been used since Vedic period for medicine and ecosystem health in Indian subcontinent. This study evaluated the dynamics in its physical characters (texture, colour, odour, temperature, EC and pH), chemical characters (macro- and micro- plant nutrients), and biological characters (organic matter, bacteria, fungus and actinomycetes) in its preparation and subsequent storage stage. Objective of the study was to prepare New *Panchagavya* following a standard protocol with some change in substitution of ingredient with locally available materials; and analyzed the New *Panchagavya* to find out days of maturity and expiry. New *Panchagavya* was sampled from 17th to 81th DAM in a regular interval bought for physical (odour, colour, texture, temperature, EC and pH) test, chemical test (macro and micro nutrients: P, K, Ca, Mg, Fe, Zn, Cu and Mn) and biological (organic matter, Bacterial, Fungi and Actinomycetes loads) analysis. Three quality windows were observed. The **New *Panchagavya*** 17-22 DAM was found with maximum nutrients and microbes while 36-51 DAM was with balanced nutrients and stable biological characteristics and 51-81 DAM was with highest humic substances and persistent microbes. The 17-22 DAM best suited for early growth period of crop. 36-51 DAM is a sustained growth period and 51-81 DAM is good for mature flowering and fruiting plants to control the pest attach and provide resistance to the diseases. The study concluded as a match application of ***Panchagavya*** should be made with timing to crop development and need.

Keywords: Ayurvedic agri-input, formative day, microbial dynamics, nutrient dynamics, stock period

INTRODUCTION

Green revolution fed the large population but ruined the soil health and ecosystem (Shiva, 1991). Consumer are now more concerned about finding safe and environmentally friendly products produced using novel farming techniques. Many indigenous farming techniques have been found to be in par with modern techniques. One such technique is the use of ancient cow-based amendment called *Panchagavya*. The term "*Panchagavya*" stems from Sanskrit, where "*Panch*" translates to five, and "*gavya*" implies cow-derived products such as cow dung, cow urine, cow milk, cow ghee, and cow curd. *Panchagavya,* the combination of these five ingredients creates a potent blend with diverse characteristics such as nutrient-rich, antimicrobial, purifying, and nourishing properties(Khanna *et al.*, 2025). This makes *Panchagavya* a versatile substance that can be used in agriculture, *Ayurveda*, and spiritual practices for promoting environmental sustainability, well-being and health.

Vedic and Cultural Background

Panchagavya, a traditional formulation of *Bharat Varsha* (the Indian subcontinent), is believed to have originated from the wisdom of *Maharshi* Dhanvantari and has been valued for its spiritual, medicinal, and agricultural significance since ancient times. The *Rig Veda* and *Atharva Veda* describe the sacredness of cows and the use of cow products in rituals and healing practices (Batra, 1986), while the *Puranas* and *Dharma Shastras* (1st century BCE–6th century CE) emphasize nature-based agricultural traditions. Classical Ayurvedic texts, including the *Charaka Samhita, Sushruta Samhita,* and *Ashtanga Hridaya*, document the therapeutic uses of cow urine, dung, milk, and ghee (Balakrishnan and Shukla, 2018);(Chandra, Geetha and Vidyanath, 2021) . Likewise, ancient agricultural texts such as the *Krishi Parashara* and *Nighantu Sangraha* recommend cow products for improving soil fertility, crop growth, and plant protection (Chaudhary, Darji and Kachchhava, 2025); (Knapp, 2005). These historical records demonstrate that *Panchagavya* has long served as an integral component of the cultural, medicinal, and sustainable agricultural heritage of India and Nepal, where its ritual and practical uses continue today (Valpey, 2019).

Table 1 provides the detailed characteristics of each *gavya* (component) of *Panchagavya* (Khanna, Bajracharya and Rinu Karmacharya, 2018; Rawal *et al.*, 2024). In Vedic rituals and ceremonies, *Panchagavya* is used as a sacred offering to deities and is believed to purify the environment and bring positive energy. It is also used in traditional practices like *Agnihotra* (fire ritual) for spiritual purification and healing (Abhang and Pathade, 2017), (Kaushal, 2025)). These ancient references to *Panchagavya* reflect the deep-rooted cultural, spiritual, and agricultural significance of cow products is a part of traditions for centuries and continues to be valued in contemporary times for sustainable living and well-being (Khanna, 2016).

Time immemorial this miraculous liquid has been used in the health and farm of the Indian continent. It is the single organic input that can act as a fertilizer, pesticide, growth promoter, and immunity booster for plants. It has demonstrated its potential to serve humankind in the dilemma of a sustainable agro-ecosystem and food production.

Table 1. Five components (*gavya*) of *Panchagavya* and their properties

Cow Dung (Gomaya)	Cow Urine (Gomutra)	Cow Milk (Ksheera)	Cow Ghee (Clarified Butter)	Cow Curd (Dahi)
Nutrient-rich: such as nitrogen, phosphorus, and potassium, which are essential for plant growth. Antibacterial properties: contains beneficial bacteria that help in breaking down organic matter and improving soil health. Purifying: cleanse the environment and neutralize negative energies	Antimicrobial: fights off harmful bacteria and viruses. Detoxifying: promote overall health and well-being of body. Insect repellent: use for protecting plants from pests.	Nutritious :rich source of protein, calcium, vitamins, and minerals Nourishing: growth, and overall vitality. Soothing-cooling: reduce inflammation or acidity. used in Ayurveda	High in antioxidants: boost immunity and fights free radicals. Digestive aid: improve nutrient absorption Nourishing: *sattvic* food that for body and mind.	Probiotic: improve digestion. Cooling: reduce inflammation. Rich in calcium: which are essential for plant growth.

Its traditional roots and modern applications underscore the significance of this ancient remedy as a remarkable gift to humankind. While traditional knowledge lauds the benefits of *Panchagavya*, efforts such as the Scientific Validation and

Research on *Panchagavya* (SVAROP) program in India are initiated to substantiate these claims through modern scientific validation (Bajaj *et al.*, 2022)

Rediscovery of *Panchagavya* for agricultural use

Professor (Natarajan, 2002) formally brought modern *Panchagavya* where he added several herbs such as jaggary, banana, tender coconut, and water besides all five *gavyas* (Selvaraj *et al.*, 2007). *Panchagavya* is used as a natural fertilizer and pesticide. It helps improve soil fertility, enhance plant growth, and protect crops from pests and diseases (Varsha and Thamaraiselvi; Varsha and Thamaraiselvi, 2025). Farmers use *Panchagavya* as an organic alternative to agro chemical, promoting sustainable and eco-friendly farming practices(Srinivasan and Aithal, 2025). In modern time research has revealed the optimal efficacy is observed with a 3% solution of *Panchagavya*, and recommended for various applications such as spray systems, seed treatments, and irrigation water mixing(Kumar *et al.*, 2025). It acts as a viable growth promoter and immune booster for plant systems, aiding in enhanced flowering, fruit quality, and shelf life (Selvaraj and Rana, 2025).

Scientists have detailed the experimentations of the product and tried to validate composition, physical, chemical, and biological behavior, and response in agricultural use. Still there is much of an immense need for scientific efforts to validate the standard formulation process, characterization, authentication, and use in Agriculture agroecosystem. This study is also an attempt to substitute the ingredient prescribed by Professor (Natarajan, 2002) with suitable but locally available ingredient ()and formulate *New Panchagavya*. Tender coconut water is a rear herb for land locked hill country like Nepal. Tender coconut water can be substitute with locally available herb like aloe vera gel. Instead of yeast with *marcha* (sourdough) can be used. Tender coconut water contains growth factors which stimulate the growth of microorganism (Naik *et al.*, 2022). Similarly Aleovera increases the population of growth-promoting Bacillus sps and Pseudomonas sps in soil (Jaramillo *et al.*, 2025); such Indigenous microorganism enhanced the phosphorous content of organic cow manure(Novia *et al.*, 2025) It also inhibit the gram positive bacteria and make safe use in agriculture(Danish *et al.*, 2020). *Marcha* a traditional starter to make home based alcohol by several ethnic community in Nepal (Sharma *et al.*, 2019) is used since it holds many yeast strain some are high amyolytic and some produces ethanol (Tsuyoshi et al., 2005). In this experiment *marcha* from Tamang community is used. This marcha have multi species of yeast, Saccharomyces sps, and non-Saccharomyces, amyolytic yeast and bacteria Bacillus sps and mold aspergillus sps (Karmacharya *et al.*, 2024). Objective of the study is to identify the quality of the product and its maturity and expiry days. This finding will make the *Panchagavya* as a potent agricultural input which can be scientifically prescribed for nontoxic farming. If this product can substitute agro-chemical use, tremendous resource, money and fuel not only saves but the pristine hill farm from ill of chemicals contamination (Wangchu *et al.*, 2024). While Panchagavya is widely used, no systematic study has tracked its physical, chemical and biological properties over time using a locally adapted formulation. This study therefore tested the hypothesis that New *Panchagavya* exhibits distinct quality during formulation and storage period. The results of this study could be used to identify the correct timing of application of *Panchagavya* for different use case.

MATERIALS AND METHODS

Formulation of New *Panchagavya*

A modified Panchagavya formulation was prepared by replacing tender coconut water with locally available aloe vera gel and yeast with marcha (traditional sourdough starter), while following the standard preparation protocol described by (Natarajan, 2002). The experiment was conducted at the Aquatic Ecology Laboratory, Kathmandu University, Dhulikhel. Fresh cow dung and cow ghee were thoroughly mixed in a clean, sterilized, sun-dried, wide-mouthed plastic bucket on first day of mixing (DAM) and ilet it formented for three days. On the fourth DAM cow urine, cow milk, curd, jaggery, ripe banana, aloe vera gel, and marcha were added(Plate 1). The mixture was stirring twice-daily (12 clockwise and 12 anticlockwise rotations). while letting furthure fermention under aerobic conditions for 15 DAM. On 19 days 30 lit of New Panchagaya was measured , if a litere of panchgavya should be made the ingredients needed is calculated in Table 2.

This final product with new locally available ingredients is called a new *Panchagavya* and was stored further for 90 DAM (days of mixing). Throughout the period of preparation and storage the bucket was covered with a thick cotton, placed in shade to protect it from insect, rodent, rain and sun light, stir 12 time clock-wise and 12 time anti clock-wise direction twice a day with a wooden stick as the metal contact was prohibited. We collected 300 ml sample at day 17, 18, 19 20, 21, 36,51,61,71 and 81DAM in a sanitized plastic bottle and stored at the Aquatic Ecological Laboratory and Microbiological Laboratory of Kathmandu

University, Dhulikhel, Nepal for further analysis. Physical characteristics colour, odour, texture and temperature were instantly observed, felt and measured with temperature probe. EC meter and pH probe used to measure the salinity, acidity of *Panchagavya* samples.

Plate 1. *Panchagavya* preparation in Lab

Table 2. Proportion of New *Panchagavya*

SN	Ingredients	Quantity (30 lit)	1 lit
1	Dung	5 kg	97ml
2	Ghee	1 kg	42 ml
3	Urine	3 lit+10 lit water	503ml
4	Milk	2 lit	77ml
5	Curd	2 kg	75ml
6	Jaggary	100 g+1 lt water	39ml
7	Banana	2 dozen	46ml
8	Aleo vera Juice	3 lit	116ml
9	*Marcha*	100 g+1 lt water	7ml

Total Nitrogen is measured by Kjeldahl method, in which wet oxidation procedure is followed, available phosphorous is measured by Vanadomolybdate phosphoric yellow colour methods and Potassium by Flame photometry methods (Jackson, 2005). We estimated Ca, Mg , Fe, Zn, Cu and Mn by the use of Atomic Absorption Spectrometer(de Oliveira, Raposo Jr and Neto, 2009). Organic matter was quantified by using dry combustion method (Nelson and Sommers, 1996). Microbial loads was calculated from colony count methods (Waksman, 1922). A Serial jump dilution technique is performed for the dense *Panchagavya* solution into a more usable concentration. Fermentation dynamics was studied by using R programming (R Development Core Team, 2023). Nutrient dynamics during storage stage can be extrapolated to understand the usable shelf-life of the quality product.

RESULTS AND DISCUSSION

Physical Properties of *Panchagavya*

Temperature, EC, pH, recorded during formative stage and storage stage is expressed in (Figure1). Temperature raised (24°C) in formative stage stabilized around ambient (22°C) throughout storage stage (Figure 1.a). EC showed notable fluctuations (19.15 to 9.65 dS/m), suggesting active solubilization and mobilization of mineral salts, followed by microbial utilization (Figure 1.b). pH drops acidic (Figure 1.c) in formative stage (during 17, 18, 19 20 and 21 DAM) but in later rises high towards neutral (4.7 to 6.2)

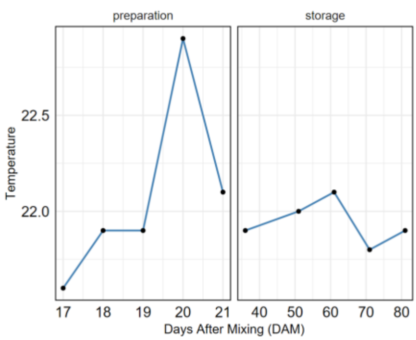

Fig1a: Temperature

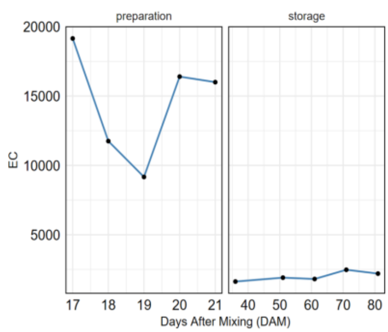

Fig1.b EC

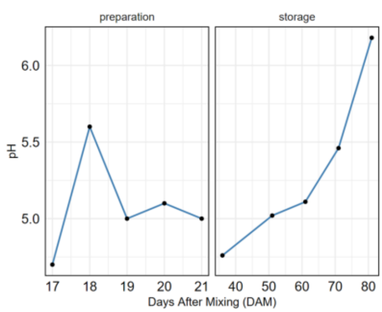

Fig 1.c pH

Figure 1. Physical properties dynamics of preparation vs storage stages of *Panchagavya*

In formative stage microbial metabolism perhaps generated heat which created a positive feedback loop (Cao *et al.*, 2025) thus a balanced fermentation complete without overheating. Thus, a self-regulating fermentation is possible for a homemade Agri-input. Nutrient cycling during *Panchagavya* formulation (Ali *et al.*, 2011) indicated direct relationship between ions (NH_4^+, NO_3^-, K^+, PO_4^{3-}, Ca^{2+}, Mg^{2+}, lactate$^-$, acetate$^-$, citrate^{3-}) and conductivity (Miller and Curtin, 2006) (Figure 2). A Strong correlation between EC peak (9.65 dS/cm) and Nutrient peak is observed. Thus, EC can be a simple field monitoring tool to examination of maturity of the *Panchagavya*. Succession of microbes from early-stage acidogenic to later-stage fermenters(Chakraborty and Sarkar, 2019); (Gore and Sreenivasa, 2011), which stabilize the medium toward near-neutral conditions which make the *Panchagavya* best for application on plants.

Qualitative parameter such as Colour, odour and texture (Table 3) assist to confirm the fermentation progress. The color shifted from greenish-brown to seaweed brown, while the odor remained fruity/pleasant throughout, signifying healthy microbial activity without putrefaction. The slimy texture was consistent with biofilm-forming microbial consortia. These parameters indicate that the preparation reached a stable, mature state by 20 days, which is suitable for agricultural use.

Table 3. Physical Characteristic of *Panchagavya*

SN	DAM	Colour	Odour	Texture
1	17	Greenish brown	Fruity smell	Slimy
2	18	Greenish brown lighter	Fruity smell	Slimy
3	19	Sea-weed brown	Fruity smell	Slimy
4	20	Sea-weed brown	Fruity smell	Slimy
5	21	Sea-weed brown	Fruity smell	Slimy
6	36	Sea-weed brown	Fruity smell	Slimy finer
7	51	Sea-weed brown	Pleasant smell	Slimy finer
8	61	Sea-weed brown	Pleasant smell	Slimy finer
9	71	Sea-weed brown	Pleasant smell	Slimy finer
10	81	Sea-weed brown	Pleasant smell	Slimy finer

There was no foul odor which indicated the putrefaction, no dark or blackish color or no sharp EC drop at storage stage. This shows that the product was very fresh up to 81 DAM. Farmer can safely use the quality *Panchagavya* for three months from date of preparation, which cover a season of crops, in 22 °C aeration with stirring and storage condition of laboratory.

Chemical properties of *Panchagavya*

This section, discuss the dynamic of macronutrients (N, P, K, Ca and Mg) and the micronutrients (Fe, Zn, Cu and Mn) of *Panchagavya* during preparation and storage phases (Figure2).

Macronutrients in *Panchagavya*

Primary macronutrient such as N, P, K and secondary macronutrient such as Ca, Mg in *Panchagavya* was analyzed during formulating and in its storage stage (Figure 2). Nitrogen (N) slowly increases day by day up to 19 DAM and shoot up (1300mg/ L) but stabilized (1230 mg/L) on 21 DAM till 50 DAM then slowly decrease (Figure 2.a) till the 90 DAM (1040 mg/L). Phosphorus (P) remained moderate fluctuations (106 to 145 mg/L) but got highest in 20 DAM during formative phase. P concentrations remarkably rises (117 to 291 mg/L) from 40 to 50 DAM, continue to fluctuate (150 then 250 to 180 mg/ L) in storage stage too (Figure 2.b). Potassium (K) very stable till 19 DAM and make highest concentration in 20 DAM (816 mg/L), and shown vey insignificant fluctuations during storage (Figure 2.c**).** Calcium (Ca) increases very slowly make highest in 20 DAM (152.0 mg/L) remain stable till 70 DAM and tend to decrease (151.0 mg/L) by 90 DAM (Figure 2.d). Magnesium (Mg) fluctuate insignificantly (47.1 to 47.2 mg/L) (Figure 2.e). High amount of N, reflect intense microbial mineralization of proteins and urea from dung, urine, and milk products**.** 45% N loss from peak (0.63%) to late storage (0.34%) might be due to volatilization, denitrification, immobilization mechanism over prolonged storage (Gore and Sreenivasa, 2011). For maximum N efficiency *Panchagavya* should be used within 30-40 DAM. This window is the growth period of plant where nitrogen is most wanted. Temperature and pH both influence N loss rate (Zhang *et al.*, 2021) , longer the storage more the loss of N. Continued microbial solubilization and re-mineralization cycles (Perumal *et al.*, 2006) might be due to active solubilization by phosphate-solubilizing microbes in the fermenting medium (Subhashini, 2016). The pH decline in formative stage due to microbial acid production (Tariq *et al.*, 2023), which enhances P and micronutrient solubility (Khan *et al.*, 2009), and reduces N volatilization losses (Gan *et al.*, 2025). Here pH acts as master control variable. A comparison of both stages highlights that preparation stage *Panchagavya* provides a more dynamic nutrient profile**,** with readily available N and P that support vigorous vegetative growth and root establishment in vegetable crop, thus best suited for a foliar nutrient spray (Subhashini, 2013). In contrast, stored *Panchagavya* ensures nutrient stability (K,

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Ca, Mg) but with reduced N (16.2%) and increase P (60.20%) availability **(Table 5), making it more suited** to support flower, fruit setting and stress tolerance.

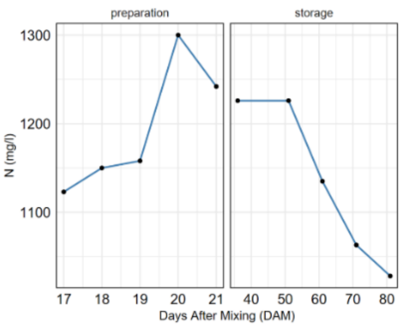

Fig2.a:Nitrogen

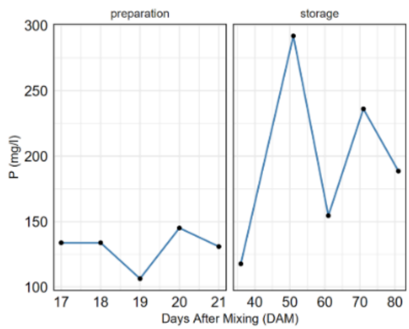

Fig2.b:Phosphorus

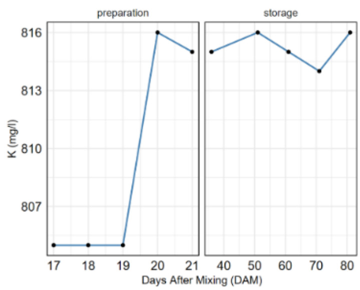

Fig2.c:Potassium

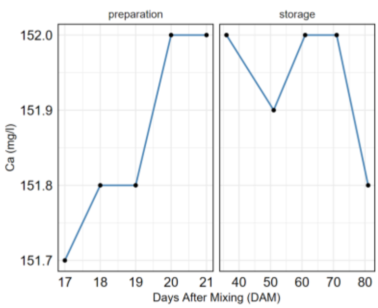

Fig2.d:Calcium

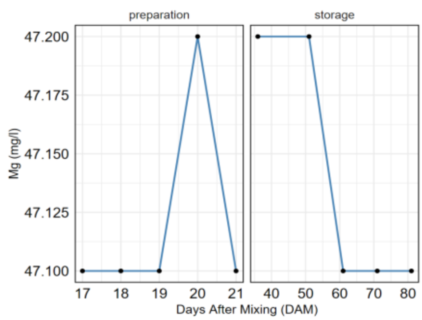

Fig2.e:Magnesium

Figure 2. Macro-Nutrient (mg/L) Dynamics of Preparation vs Storage stages of Panchagavya

Table 4. Macro-Nutrient peaks and loss during storage

Nutrient	Peak DAM	Peak Value (mg/L)	Storage Start (mg/L)	Storage End (mg/L)	Change in Storage (%)
N	20	1300	1226	1028	−16.2%
P	20	145.1	117.7	188.6	60.20%
K	20	816	815	816	0.10%
Ca	20	152	152	151.8	−0.1%
Mg	20	47.2	47.2	47.1	−0.2%

Micronutrients in *Panchagavya*

Dynamics of micronutrient such as Fe, Zn, Cu and Mn of *Panchagavya* was analyzed during the formative stage and storage stage (Figure 3). Iron (Fe) gradually increased (29.12 mg/L) by 20 DAM. Stabilized for the period of three weeks and remain same for the period of 90 DAM (Figure 3.a). Zink (Zn) is present in *Panchagavya* throughout the period of formation till storage (Figure 3.b) with minor fluctuation (1.76 to 1.77 mg/L). Cupper (Cu), fluctuate in both the stage, slightly declining (2.5 to 2.2 mg/L) in preparation stage and slightly increased (2.4 to 2.5 mg/L) during the storage (Figure 3.c). Manganese (Mn) rose (1.6 to 2.2 mg/L) steadily during preparation and still raises up to (2.2–2.4 mg/L) during storage stage (Figure 3.d).

All micronutrients Fe, Zn, Cu and **Mn** too peak together at 19 DAM, perhaps might be due to microbial organic acids. Acidic pH maximizes solubility of Fe, Mn, Zn, Cu solubility (Gondal *et al.*, 2021). Thus, *Panchagavya* is a micronutrient chelate source**.** Chelation improves absorption and utilization of essential nutrient in various organism, leading to better health and productivity in plants**.** Fe help to prevent chlorosis in plant, Zn ensure hormone regulation, auxin synthesis, pollen viability**,** flowering, fruiting and the seed development**,** Cu remains adequate for enzyme activity and lignin formation, enhancing resistance to pathogens, plant-available Mg forms contributes to photosynthetic activity and nitrogen assimilation (Somasundaram and Amanullah, 2007) This readily available micronutrient ensures uniform growth, continuous chlorophyll activity, and better fruit development throughout the cropping. Thus, *Panchagavya* is best suited for a foliar nutrient spray or drenching. A comparison of both stages highlights that both preparation and storage stage Fe and Mn raise till 81 DAM, whereas Zn and Cu fluctuate and still remain in same quantities for the period of 81 DAM. Thus, extrapolation suggests the *Panchagavya* can be safely store up to 90 days in shade

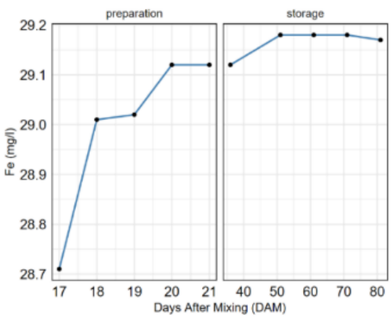

Fig 3.a: Fe

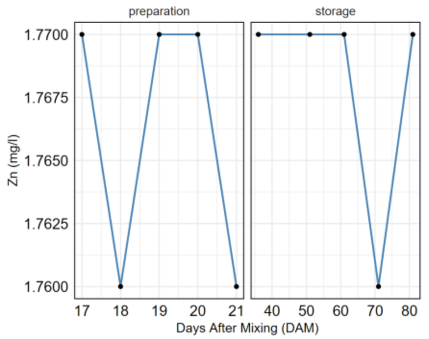

Fig 3.b: Zn

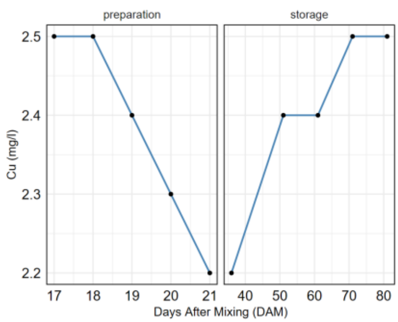

Fig 3.c: Cu

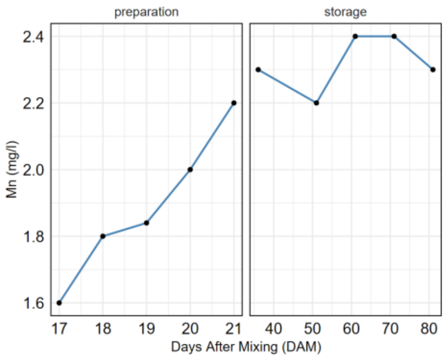

Fig 3.d: Mn

Figure 3: Micro-Nutrient (mg/L) Dynamics of Formation vs Storage stages of *Panchagavya*

Biological Properties of *Panchagavya*

Dynamics of organic matter (OM), and microbial loads such as bacterial colony count (BCC), fungal colony count (FCC) and Actinomycetes colony count (ACC) of *Panchagavya* was analyzed during formation stage and in its storage stage (Figure 4). OM rose rapidly (Figure 4.a) till 19DAM (31.16% to 150%), with some fluctuation fall down and almost exhaust by 60 DAM (8%). BCC in *Panchagavya* increases up by 20 DAM ($11X10^{10}$CFU/ml), sudden burst on 21DAM ($35X10^{10}$CFU/ml) and slowly decline through Storage period, remain good amount of bacteria $20X10^{10}$CFU/ml by 81DAM (Figure 4.b). Good FCC

(18X10^{11}CFU/ml) observed on 17DAM, and a regular raise up to 28X10^{11}CFU/ml by 19 DAM (Figure 4.c), then continue to decline for a while and make up by 60 DAM which further lower down in (13X10^{11}CFU/ml) late storage phase. ACC increase very slowly in initial days of formulation (2X10^{3}CFU/ml to 5X10^{3}CFU/ml). Actinomycetes shoot up on 60 DAM (20X10^{3}CFU/ml) then slowly reduce during Storage period (Figure 4.d) still remain (15X10^{3}CFU/ml) in 81 DAM.

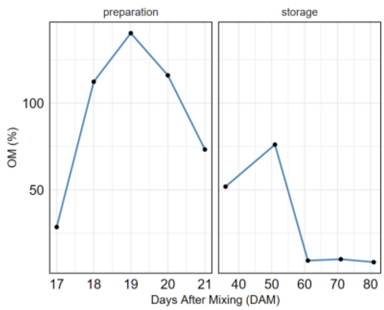

Fig 4.a: OM

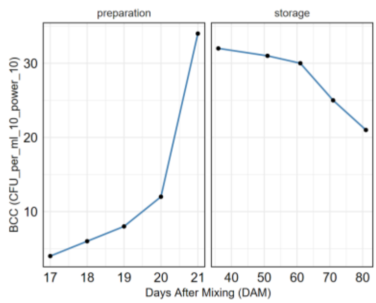

Fig 4.b:Bacterial load

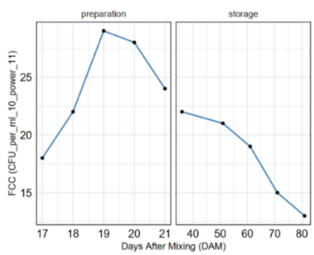

Fig 4.c:Fungal load

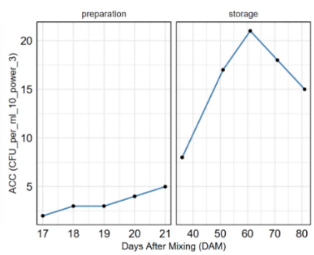

Fig 4.d: Actinomycetes load

Figure 4. Organic matter % and microbial loads (CFU/ml) dynamics of *Panchagavya* during formation vs storage stages

The biological profile of the *Panchagavya* mixture shows three oligotrophic conditions and clear Microbial Successions. a rapid rise in organic matter and microbial counts during the formulation. Phase 1 (17-22 DAM) where r-strategist bacteria dominate. Phase 2 (22-36 DAM) K-strategist fungi/actinomycetes increase. Basal metabolism maintains populations without growth. Phase 3 (51-81 DAM) Recalcitrant OM provides slow-release carbon source for Climax community and acidic pH prevents competitor invasion (Brant, 2005). Initial OM is Labile substrates produce rapid acid and pH tends to decrease (Chen *et al.*, 2012), final OM is Recalcitrant humic substrates (stable form), is slow in acid production (Marschner *et al.*, 2008).

This multiple biological and chemical transformation are depicted by change in colour of *Panchagavya.* (Nursten, 2005), explained Millard reaction where three processes intensify with time and microbial activity. Amino acids and sugars changed to melanoidins which is brown in colour. Humification occurs where microbial enzymes give humic acids which is dark brown in colour. Phenolic oxidation where polyphenol oxidase changes to quinones which is brown in colour. All the phases offer different benefits to plants and soil. Early *Panchagavya* is good for nutrient amendment and late *Panchagavy*a is best for soil conditioning.

CONCLUSION

Panchagavya evolves through three quality windows. The product can be stored for up to 81 days under the conditions tested. Stored product should be matching the application with timing to crop need. Early window for vegetative growth, later window for flowering/fruiting. Extended store of *Panchagavya* may lose its quality, thus it should be used before its drops.

There was potential variability due to seasonal/ regional differences in raw materials and cow product.

RECOMMENDATIONS

The results of the study were drawn within certain limitations, which should be corrected in future experiments.

1. Sample from late formative stage (17, 18, 19, 20, 21 DAM) was taken every day. But sample during storage stage was measured on the day of Panchagavya used for the crop, where the gaps were 10-15 days. It is now realized that the analysis for formative and storage sample data gap are too short and too large. For future experiment it is recommended to omit this limitation by giving equal interval of 3-5 days.
2. Single sample was analyzed due to resource constraint. It is recommended for future experiment to collect sample in duplicate or triplicate.
3. Soil and crop response of *Panchagavya* application should be addressed in future work.
4. Multiple experiments on scientific validation of this formulation has to be conducted in future.

5. The cow product may differ based on breeds of cow as well. It can be addressed in future experiment.

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