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Comparative Study of Organic Manures on Post-Harvest Quality of Cauliflower

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Cauliflower (*Brassica oleracea* var. *botrytis* L.) an important crop species of the Brassicaceae family is among the highly grown vegetable crop in Nepal. In Nepal cauliflower is grown mostly by using a combination of organic and inorganic manures where the ratio of inorganic manures dominates the organic one. Inorganic manures are also important as these provide nutrients to the soil which in turn provide them to crops at a faster rate but for a short period whereas organic manures supply nutrients for a longer time and at a constant rate of supply. Post-harvest refers to the stage at which the commodity is further processed after harvest. Even though cauliflower is among the highly perishable natural crops its consumption is not seen within an hour of harvest as it passes through different phases of supply in a complicated market structure. To keep cauliflower fresh for a longer time during marketing organic manures can be considered the best option. Different organic manures have variations in their post-harvest characterization when observing different research, it has been found that vermicompost is considered to be the best fertilizer for organic cauliflower production as Total Suspended Solids (TSS) ratio, Vitamin C ratio, shelf life, and preferences among the consumers are highest among the consumers when cauliflower is grown in this nutrition media. Other organic media such as farm yard manure (FYM), poultry manure, leaf litter compost, mustard, and neem cakes as well as different biofertilizers such as Azolla, Azotobacter, and Phosphate solubilizers can also be used as a better option to enhance post-harvest characteristics than using chemical fertilizers.

Key words: Cowdung, farmyard manure (FYM), poultry manure, shelf life, vitamin C, vermicompost, yield.

INTRODUCTION

The essential component of a human's diet that they must include every day is vegetables. When referring to vegetables, there is no specific product or commodity in mind; rather, the term "vegetables" refers to a wide range of families, species, and varieties. These various species need particular requirements for their healthy growth and fruitful bearing. As some grow best in summer, some in winter while the spring season favors some vegetable

species production. Among the several vegetable species, cauliflower (*Brassica oleracea* var. *botrytis* L.), a key crop in the cole family, that is, "Brassicaceae or Cruciferae" genus *Brassica* is grown throughout the winter months (Pawar et al., 2018). Because the flowers have four petals and resemble a Greek cross, they are referred to as "cruciferous" (USDA, 2019). The Mediterranean basin, and especially its east coast, would

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appear to have played a vital role in the genesis of cole crops like cauliflower and broccoli (Gray, 1982; Smyth, 1995). The Latin terms "Caulis and Floris", which respectively imply "stem or stalk and flower", are the origin of the name cauliflower. Annual plants known as cauliflowers, grow to a height of around 0.5 m (1.5 feet) and have enormous, spherical leaves. The terminal cluster develops a solid, succulent "curd," or head, a juvenile inflorescence prized for food (cluster of flowers). It is grown for its appealing curd that has a delicious flavor, easy digestion, an abundance of nutrients, and great yielding potential, mostly used in pickles, curries, soups, and raw vegetables (Bhowal et al., 2021). Before harvest, the broad leaves are frequently knotted together to shade the curd and prevent discoloration.

The broad leaves stretch well over the curd. Although there are orange, purple, green, and brown cauliflower varieties, white cauliflower is the most typical commercial variety. Yellow flowers in a cross form are produced by the plants, and siliques, or dried capsules, are used to store the seeds (Petruzzello, 2022).

Cauliflower thrives most successfully between latitudes 11 and 60°N, where the typical temperature ranges from 5-8 to 25-28°C. During the vegetative growth stage, cauliflower may survive for a few days in temperatures ranging from -10 to 40°C (Singh et al., 2018). The top 10 countries producing the most cauliflower are China (37.21%), India (34.67%), the United States (4.94%), Spain (2.93%), Mexico (2.69%), Italy (1.43%), Turkey (1.22%), Bangladesh (1.11%), France (1.01%), and Algeria (0.95%). Spain is the top exporter whereas United Kingdom top importing country of cauliflower in year 2021 (Tridge, 2023). According to Timilsina et al. (2020), the cultivated area of cauliflower in Nepal is approximately 34967 ha, and it produces nearly 550,044.8 tons/ha, about 13% of total vegetable production.

Cruciferous vegetables are rich in vitamins, minerals, and a particular class of compounds that have anticancer properties (Moreno et al., 2006). Because of its nutritional qualities, contribution to human nutrition, and other health advantages, the use of organic fertilizer in the cultivation of crucifers is advised (Salunkhe and Kadam, 1998). Cauliflower is a high feeder of mineral elements, and like other members of its family of vegetable crops, it also takes up a lot of soil's macronutrients. When chemical fertilizers are applied it not only determines the crop condition in the field but also affects the overall appearance of the crop in different parameters during storage. Due to inappropriate handling, storage, preservation methods, and microbial deterioration, perishable fruits and vegetables make it easier for microbes to assault them (Sharma et al., 2013). The use of postharvest technologies can lower the quantity and quality of fresh fruit and vegetable losses while also preserving product quality up until final consumption. The focus should be placed on cultivating agricultural products with longer postharvest lifespans to ensure their cleanliness (Wasala et al., 2014). Thus, to ensure

better post-harvest characteristics organic manuring or practices during cultivation should be practiced. Growing organically offers growers several advantages. It is an environmentally beneficial way of farming and lowers production costs. To increase yields, traditional farming typically uses excessive amounts of inorganic fertilizers (Stewart et al., 2005). Different chemical reactions occur between the commodities during storage conditions when they are grown chemically while organic products are less vulnerable to post-harvest deterioration (Bhattarai and Budathoki, 2005).

Most of the cauliflower grown in Nepal is influenced by the use of chemical fertilizers which affects the storage ability of crops, as a result deterioration is faster in cauliflower. These problems can be minimized by the application of organic manure at the time of growth of the crops. As organic manures extend the photoperiodic activities in crops and boost the final produce immunity against different diseases. This review paper will address most researchers' and grower's queries on how cauliflower is grown organically be stored for longer times as well as will summarize the changes in the overall qualities and characteristics of cauliflower during storage.

METHODOLOGY

This review was conducted utilizing secondary data from various journals like Springer, Elsevier, MDPI, Google Scholar, Research Gate, and technical reports, all of which were shared with the authors. The review mainly focuses on the qualitative and quantitative changes in the cauliflower during post-harvest operations which were grown using organic manures. Despite the vast number of articles found for each subtopic, few articles were found relevant. The data from those selected articles were used.

RESULTS AND DISCUSSION

There is variation in the nutrients contained in organic manures as well. The proportion of the basic nutrient, commonly referred to as the macronutrient varies in different manures. The term "cow dung" is frequently used when discussing organic manure; however, there are numerous additional sources from which organic manures can be obtained. The farmyard manure (FYM) alone contains respectable amounts of nutrients that, during decomposition, becomes available to plants in addition to improving the availability of both native and applied nutrients (Chander et al., 2010). Some of the major forms of organic manures that can be used during cauliflower cultivation along with their pre and post-harvest effect on production can be discussed in the following subheadings.

Vermicompost

Vermicomposting is a straightforward biotechnological

method of composting in which specific species of earthworms are employed to speed up the waste-to-product conversion process, which includes the breakdown of decomposable foods, bedding materials, and other organic materials (Adhikary, 2012; Belbase and Bc, 2020). Vermicompost is an excellent source of organic fertilizer since it has a strong microbial population, high amounts of NPK, that is, Nitrogen ranging from 2-3%, Phosphorus 1.55-2.25% and Potassium about 1.85-2.25% along with plant growth hormones, and enzymes that boost plant output (Sinha et al., 2009). It also provides cauliflower with low nitrate and high vitamin C content (Chaoui et al., 2003). Vermicompost application greatly enhances plant height while improving the soil's physical characteristics, particularly its porosity and water-holding capacity, and supplying additional growth-promoting elements (Jahan et al., 2014). In a variety of crops, vermicompost increased fruit diameter. Chemical analysis showed vermicompost contains significant amounts of essential elements, such as sodium, potassium, calcium, magnesium, copper, nitrate, and chloride, that are beneficial to healthy growth (Khan and Ishaq, 2011). Farahzety et al. (2013) claim that using vermicompost made from vegetable wastes increased curd weight a little bit more than using synthetic fertilizers. Vermicompost application causes early curd initiation and maturity in cauliflower compared to other synthetic fertilizers as well as many organic fertilizers which may be caused by the balanced plant nutrients and hormones included in vermicompost. Due to the key ingredients in vermicompost, which improved vitamin C production, it may have the highest vitamin C level. Due to the usage of vermicompost, it was discovered that the quality criteria such as fruit density, post-harvest life, and total suspended solids (TSS) were at their highest levels. Higher fruit density is only caused by more reserved substances accumulating in fruit, similar to higher fruit weight. Fruits with a higher solid content may have had a longer shelf life. Due to the higher metabolite content in fruit, TSS is also rising when the number of vermicompost increases (Singh et al., 2010). According to Basnet et al. (2018) when vermicompost was used, there was reduced physiological loss of curd weight (33.81%) than using other synthetic fertilizers in field conditions.

Vermicompost promotes the development of healthier, more compact, and visually appealing heads, while also contributing to a sweeter flavor. Additionally, the improved soil health from vermicompost increases the plant's resistance to pests and diseases, leading to reduced spoilage and a longer shelf life.

Farmyard manure (FYM)

FYM refers to organic fertilizers made mostly from the excrement and urine of farm animals, primarily cows, and

buffaloes. FYM is full of nutrients for the soil and plants, but nitrogen predominates.

Vermicompost application resulted in the largest stem diameter in crops, but employing organic manures resulted in the smallest diameter (Kumar et al., 2007).

The largest diameter may result from nutrients being readily available to the plants, while organic manures with smaller diameters may have less release or slower release of nutrients as a result of mineralization. Compared to crops grown using inorganic nutrient sources, vegetables that are grown organically may have more than 25% higher Vitamin C (Schuphan, 1974). Cauliflower's vitamin content decreases after being treated with FYM. The cause may be related to the important nutrient's sluggish release (Basnet, 2018). The application of FYM instead of chemical fertilizer increases carotenoid content in kale (Qureshi and Wani, 2014). Following the administration of FYM, an increase in the content and activity of chlorophyll and related light-absorbing pigments (including carotenoids) may be responsible for the increased carotenoid content. Since FYM has more potassium and carbohydrates, the synthesis of ascorbic acid is favored (Salisbury and Ross, 1991). Farmyard manure enhances cauliflower's post-harvest quality by improving nutrient uptake, soil structure, and water retention. This results in healthier, firmer heads with better flavor and extended shelf life, while also reducing post-harvest diseases

Compost

It is organic manure formed from a mixture of organic material that has rotted or is deteriorating. Typically, it is created by piling plant waste, including leaves, tiny, succulent branches, such as grass clippings, and vegetable peels into a bin or pile and allowing it to decompose (Beck, 2023). Cow dung manure and other ingredients are frequently added to the combination to improve it or hasten its decomposition. Composting increases the phytonutrient content of plants, encourages root formation, increases fruit setting and yield, and enhances root formation (Atiyeh et al., 2002). When compared to vermicompost, compost use resulted in lower vitamin C concentration (12.18 mg/100 g), which could be a result of the low nutrient content and sluggish nutrient release in compost fertilizers (Belbase and Bc, 2020).

Poultry manure

It is an organic waste primarily made up of bedding materials and poultry excrement and urine. Due to the accumulation of solid feces and poultry urine, which together provide vital nutrients for the general growth and development of plants, the poultry manure contains a

greater amount of nutrients than synthetic fertilizers and many organic fertilizers like FYM, Vermicompost, mustard cake, etc (Amanullah et al., 2007).

Bhattarai and Budathoki (2005) located higher weight loss of curds when treated with chemical fertilizers and controls, may be caused by a deficiency in the micronutrients necessary to fortify the curd's cellular and subcellular components. A second explanation for the significant weight loss linked to chemical fertilizers could be the increased vegetative growth induced by these fertilizers, particularly nitrogenous fertilizers, which result in increased moisture storage in plant parts. Naturally, degradation and weight loss will occur more quickly the higher the moisture level. The least weight loss was seen in poultry manure, which may be related to the presence of enough micronutrients for cauliflower to produce curds. When the cauliflower was treated with poultry dung instead of other chemical fertilizer source its vitamin C, protein, and calcium contents increased while its carbohydrate level slightly decreased (Jose et al., 1988).

Mustard cake

Byproduct obtained from mustard after extraction of oil from dried mustard seeds is known as mustard cake. It has a lot of micronutrients, including potassium, phosphorus, and nitrogen, and it also has herbicidal properties that guarantee better root growth and optimum consumption of nutrients from the soil (The House of Terra, 2021).

According to Akhter et al. (2019) all growth parameters, including plant height, several leaves per plant, largest leaf length (cm), largest leaf breadth (cm), days needed for curd initiation, length of curd (cm), curd stem diameter (cm), curd weight (kg), curd diameter (cm), yield per plot (kg), and yield per hectare, perform better when mustard oil cake is applied 15 days before planting cauliflower (ton).

The major parameters seen during post-harvest observations are as follows:

Physiological loss in weight (PLW)

The percentage difference between the initial weight and the weight at the time of measurement is known as physiological loss in weight (PLW). It can be expressed in the formula as:

$$PLW = (\text{Initial weight of commodity} - \text{Final weight of commodity}) / \text{Initial weight of the commodity} \times 100\%$$

Vitamin C

Brassicales (Cauliflower) are touted as healthful, strong sources of vitamin C and possess a wide range of health-

promoting chemicals. An increase or preservation of the vitamin C content would result from the proper management of pre-and post-harvest elements, including crop varieties, growth circumstances, harvesting, handling, storage, and final consumer processes (Domínguez-Perles et al., 2014).

Shelf life

The period during which a food product may be counted on to maintain its quality attributes is known as its shelf life. Food quality is reflected in several areas, including safety, nutritional value, and sensory qualities, including shelf life. Food quality is impacted by shelf life, which in turn affects consumer purchasing choices (Barrett, 2007).

Organoleptic taste and sensory evaluation

Organoleptic evaluation based on size, shape, color, taste, compactness, and freshness is used to gauge consumer approval. Consumer acceptance was observed in the organically grown cauliflower rather than the chemically grown variety, according to Bhattarai and Budathoki (2005). This may be because the curd received vital nutrients over a longer period.

CONCLUSION

Cauliflower is one of the major grown and most consumed vegetable species in Nepal. The findings of different researches show that cauliflower grown organically absorbs nutrients at a slow rate but for a longer period, this influences the overall production and quality of products as compared to inorganic fertilizers. Most sources of organic manures also have a positive impact on the post-harvest characterization of cauliflower as the ratio of TSS, vitamin C content, shelf life, and carotenoids content are higher in organic cauliflower. The preference among the consumer is also high in the case of organically grown cauliflower as its tastes better and aromatic than chemical ones.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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