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WASTE MANAGEMENT PRACTICES IN IDENTIFIED PACKHOUSES FOR GRAPES AT NASHIK DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT

This research work was conducted on "Waste Management Practices in identified packhouses for grapes at Nashik District, Maharashtra". The pack house plays a crucial role in the export of grapes (*Vitis vinifera*), and several operations were carried out to preserve the grapes quality. Different wastes generated in the packhouses were surveyed and their utility was analyzed. A total of nine packhouses were included in the survey. Plant managers, executive officers in charge of quality control, and production executives were interviewed. A standard questionnaire was created for data collection. Various parameters to fulfill the objectives were included in the questionnaire. Observations showed 4 pack houses showing damage and no loss during transportation in 5 packhouse from farm to packhouse. Upon reception, the weight of the grapes was recorded and the waste generated by each of the eight packhouses was noted that ranged from 26.23% (packhouse 4) to 37.6% (packhouse 3) over the period of ten days. The different packhouses utilize their waste as raisins and animal feed (44%) and vinery (6%) etc. Wastes were also utilized as by-products such as manure (21%), animal feed (21%) and new product development, (NPD) (58%). This data can be beneficial to the packhouse to review their process and to reduce the waste thereby increasing the economic return of the packhouse and reducing the pollution to the environment.

KEY WORDS: Packhouse, Packing, NPD, Quality control, Waste.

INTRODUCTION

Fruits and vegetables are essential to human nutrition and health. The demand for these vital food items has skyrocketed due to changes in dietary practices and the world's expanding population. Increased growth and production, along with inadequate infrastructure and handling techniques, have resulted in significant losses and wastage of these vital food commodities, along with their constituent parts, residues, and byproducts. According to estimates from the United Nations Food and Agriculture Organization (UNFAO), at least one-third of the world's fruit and vegetable production- roughly 1.3 billion metric tons- is lost or wasted annually, with horticultural commodities experiencing the highest losses and waste of any food category, reaching up to 60%.

Losses and waste occur during all phases of the supply and handling chain, including during harvesting, transport to packinghouses or markets, Waste, on the other hand, the fruit or vegetable that is fit for consumption, but is not consumed and instead discarded, and this generally relates to consumer or retailer behavior. Losses and waste are related and often difficult to identify, therefore they are referred to jointly or in conjunction even though they can be seen as separate concepts with separate causes and solutions. Both quantitative and qualitative methods can be used to evaluate losses

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and waste (FAO, 2011). Both rich and developing nations experience significant losses and waste from horticulture goods, but at various stages of the handling chain. Rich societies in emerging countries produce less waste than those in industrialized countries. Put another way, technological constraints in infrastructure and handling, such as storage, packing, packaging, and marketing, are typically the cause of fruit losses. While fruit waste is commonly the result of negligence or a conscious decision to through fruit away (Sagar *et al.*, 2018).

According to global statistics, there were 7449 hectares under grape cultivation worldwide in 2018-19, with a yield of 77.8 (MT) and a productivity of 10.9 (in ton/ha). Area designated for the production of table grapes, dried grapes, or wine grapes. Due to the fact that China leads the world in grape production and Spain leads the world in grape cultivation, respectively. Production of wine is 292 mhl (million hectoliters), that of table grape is 27.3 MT, that of dried grape is 1.3 MT, and that of wine is 57%, 36%, and 7%, respectively (Source: DGCIS Annual Export, 2019-20).

70% of the grapes grown worldwide are utilized to make wine, unlike in India. However, a sizable amount of grapes are also utilized for table purposes for manufacturing wine in Italy, Chile, Argentina, Brazil, and the USA.The main states that cultivate grapes are Punjab, Haryana, Western Uttar Pradesh, and Maharashtra in the north, and Karnataka, Andhra Pradesh, and Tamil Nadu in the south. Maharashtra has the top position in terms of production, contributing about 81.22% of the nation's total production and having the highest productivity. The nation exports a significant amount of grapes to the global market. During 2018-19, the nation exported fresh grapes valued at 233525.08 lakhs, totalling 246133.79 (in MT). Additionally, during the 2019-20 fiscal year, the nation exported fresh grapes valued at 217686.82 lakhs, totalling 193690.54 (in MT). The major destinations of India's grapes were Netherland, Russia, UK, Bangladesh, Germany, United Arab Emirates, Saudi Arabia, Thailand, Hong Kong, Malaysia and Others countries **(**Chavan *et al.*, 2024).

In addition to lowering fruit supply, post-harvest losses raise the cost of marketing and transportation per unit. This has an impact on consumers (higher prices and decreased availability) as well as producers (loss in price share). Macroeconomic estimates suggest that India loses fruits valued at approximately Rs. 13,569 crores (based on 30%) every year. Reducing post-harvest losses is an additional strategy to boost production; that is, preventing losses comes at a lower cost than growing the same amount of extra fruit (Murthy *et al.*, 2009).

The primary aim of commercial grape growing in India is table grapes, and the country boasts one of the highest productivity levels worldwide. Maharashtra is the state where grapes are grown the most, followed by Karnataka, Tamil Nadu, Mizoram, and Andhra Pradesh. Grapes are also produced in a few northern states, including Jammu & Kashmir, Himachal Pradesh, and Punjab. While about 27% of the grapes are dried for raisin production, 1.5% are used to make wine, and 0.5% are used to make juice, 71% of the grapes produced are suitable for table usage. Among white grapes, the most widely grown types are Thompson Seedless and its clonal selections, including *Tas-A-Ganesh, Sonaka*, Super *Sonaka*, *Manik Chaman*, and *Sudhakar* Seedless. The most widely grown colored table grape types in the nation are *Sharad* Seedless, *Nana* Purple, *Sarita* Seedless, Flame Seedless, Red Globe, Crimson Seedless, etc. In addition to colored cultivars, Thompson Seedless and its clonal selections, such as *Tas-A-Ganesh* and *Sonaka*, are the primary sources of raisins (Sharma *et al.*, 2018).

Dried grapes are mostly grown in the districts of Vijayapura and Bagalkot in Karnataka and Sangli, Solapur, Nashik, and Osmanabad in Maharashtra state, India. Roughly twenty-nine percent of all grapes produced are made into raisins. When it comes to producing table grapes intended for export, the set of procedures used is distinct from those of producing raisins. India produces dried grapes by dipping grapes using an Australian technique (Sharma *et al.*, 2020).

By-products and leftovers from the grape industry are examples of agro-wastes, which are produced when crops or animal products are processed for human consumption. Pomace, peels, molasses, and shells are examples of recyclable wastes that can be converted into a variety of goods or raw materials for use in other sectors by using the right pretreatment techniques (Somayeh *et al.*, 2015).

The primary infections of great economic relevance that is predominant, such as bunch rot (Botrytis cinerea), powdery mildew (*Erysiphenecator*), and downy mildew (*Plasmoparaviticola*), can be separated from the less common ones that only occur locally or momentarily. The downy mildew causes white,

leathery-looking fungal growth on leaves, stems, and tendrils. It also causes white, leathery fungal growth on berries. Berries infected become hard, bluish green, and eventually brown. This disease's symptoms are often mistaken for powdery mildews. Many areas with humid growing seasons suffer from the devastating illness known as black rot, which is brought on by the fungus *bidwellii* (Kellner *et al.*, 2022).

Hence this study was undertaken to survey the different waste generated and to analyse their utilization in identified pack houses.

MATERIALS AND METHODS

The experimental plan for the present study is presented in Table 1.

Methods

1. Survey of the Packhouses 2. Analyze the waste generation. Fig 1 shows the flow chart followed for the study.

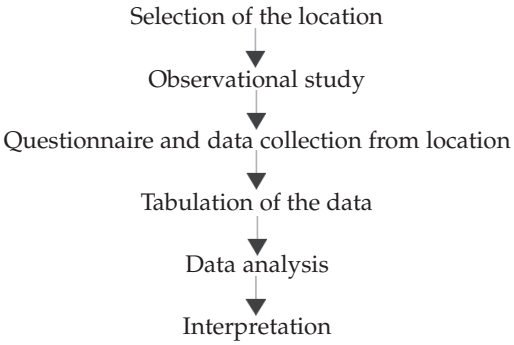

Fig. 1. Flow chart of the study

Selection of the location for Study

The first step for the study was selection of the area. Nashik (Maharashtra) was selected and 9 packhouses were identified. The main parameters which were considered during selection of packhouses was location of the packhouse, raw materials, and the different governmental acts that to be followed by the grape industries [Pollution Prevention Technique, environmental (Protection) Act, air (Prevention and Control of Pollution) Act, water (Prevention and Control of Pollution) Act]. From these packhouses the survey was done along with waste data was collected and studied how the waste was utilized and used for further processing's like raisins, animal feed, manure.

Observational study

All the details could not be collected by the questionnaire so a proper grape waste analysis study according to Fig. 1 was done to have a complete detailed idea of analysis of work related to packhouses. Basically, this study was carried out to keep a record on total waste occurred during operations of grape processing.

Questionnaire and data collection

According to Fig. 1 a questionnaire was prepared for the different packhouses and vinery to get details about their general information like location, nature/source of raw material, solid/ liquid waste annually and different governmental acts, along with the waste generated for 10 days, in packhouse during various operations like grading, sorting, cleaning and packing. After all the data was collected then it was tabulated accordingly.

Mathematical tools used

The tools which were used for analysis
- Graphical analysis
- Pie chart

Graphical analysis

The graphical analysis creates pictures of the data, which will help to understand the patterns and the correlation between process parameters. Often graphical analysis is the starting point for any problem-solving method.

Pie chart representation

A type of graph which helps to represents a

Table 1. Experimental plan

Variable	Description
Industry	Pack House for Grapes
No. of packhouses	$I_1, I_2, I_3, I_4, I_5, I_6, I_7, I_8$
Collection of data	By visiting grape packhouses
Analysis	Grape export packhouse questionnaire Waste calculation of grapes
Industrial study	Duration 3 months
Statistical analysis	Graphical analysis and Microsoft Excel was used for analysis and fulfill the objectives

proportion of the whole through sectors in the divided circle. It's a powerful visual tool to represent and compare percentage and proportions.

RESULTS AND DISCUSSION

Survey of different waste generated in grape pack houses

In order to understand the background characteristics of the pack house and its operations, the general information was required because it helps in interpretation of the results. Apart from the basic information, other variables were also noted to have a deeper understanding. Year of establishment of the industries, loss during transportation and by product recovery by the unit etc were few that are recorded in this study.

Year of establishment of pack houses

The year of establishment of the pack houses visited are shown in Fig. 2. Three of the pack houses were only four years old, four were between the ages of ten and twenty, and two of the industries were 22 years old. These indicate that the pack houses that are functioning for long years have better waste utilization management than recent ones. Grapes and other in-season fruits and vegetables are exported by all industries to various international markets. These industries mostly export grapes; the leftover waste grapes are processed to make raisins and are distributed to vineyards to grow vines. These related studies conducted by Bertran *et al.* (2004) stated that the Sludge from organic wastewater treatment plants and grape stems are two examples of the various biological wastes produced by wineries. These residues can be reintroduced to the soil through composting.

Nature of Loss during transportation

Four pack houses displayed damage to the grapes as a result of incorrect handling during harvesting, crates without a bubble sheet, and road conditions, which caused more damage to the grapes. The results in Table 2 are almost similar as Sharma *et al.*, (2018) stated that 30% of India's fresh produce is rendered unfit for consumption as a result of spoilage after harvesting. The postharvest loss in grapes has been recorded by various workers within the range of 8.23 to 16% in the country. As per present estimate, India is losing about 223 thousand tonnes of grapes annually which is 8.23% (Associated Chambers of Commerce and Industry of India (Assocham)

Table 2. Nature of loss during Transportation

Packhouses	Nature of loss during Transportation
Packhouse 1	Damage
Packhouse 2	Noloss
Packhouse 3	Noloss
Packhouse 4	Damage
Packhouse 5	Damage
Packhouse 6	Damage
Packhouse 7	Noloss
Packhouse 8	Noloss
Packhouse 9	Noloss

By-Product recovery adopted by the unit

Here in Fig. 3, it is observed that nine Packhouse produced different types of by product recovery as NPD (jam jelly) 58%, manure 21% and animal feed 21% similar studies with (Kumar and Babu, 2021). stated that the grapes processed for producing a wide range of products, including raisins, wine, grape seed oil, jam, jelly, and juice concentrates. Nistor *et al.*, (2014) explained the use of grape pomace on milk yield and milk composition in dairy cattle. Kumanda *et al.*, (2019) states that the After 6–9 months of composting, pomace is added to the soil with the help of various inoculants to recycle nutrients. Because fresh red grape pomace (GP) has a low pH, contains phenolic compounds with

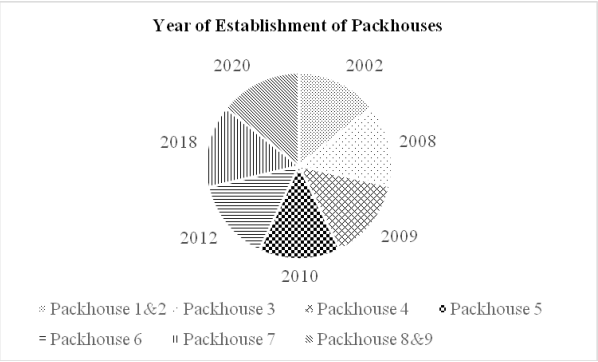

Fig. 2. Year of establishment

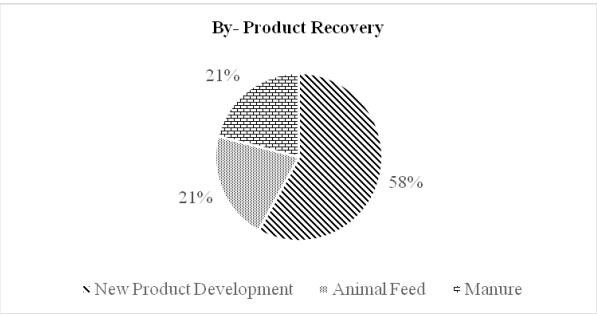

Fig. 3. By-product recovery

antibacterial capabilities, and can bind and restrict the availability of some plant nutrients, adding GP to the soil without composting may have a negative impact on soil fertility.

Analysis of waste generated in grape packhouse and its utilization

In order to understand the background characteristics of the packhouse and its operations, the general information was required because it helps in interpretation of the results. To analyze the utilization waste generated by the unit.

Quantity of solid waste generate by the packhouse

The table 3 shows quantity of solid waste generated by the Packhouses is one of the most significant features in interpreting the results on specific issues. The packhouses showing the waste generate in packhouse in a year. Consistent with other studies Kisten (2020) stated that the significant contrasts between the 2017 and 2018 seasons, with the defeats in the latter half of the season's total. Mechanical damage (7.1% in 2017 and 3.09% in 2018) resulting from crates being handled roughly was the primary cause of losses at the packhouse level and may be reduced by raising worker awareness of the need for careful crates handling. Since delayed harvesting lowers shelf life and increases postharvest losses, harvest timing is also crucial.

Waste Generated (%) by the Different Packhouses

Waste was computed using the total amount of grapes received, resulting in an average waste

Table 3. Quantity of solid waste generated by the packhouse

No of Packhouses	Waste in [MT]
Packhouse 1	289
Packhouse 2	220
Packhouse 3	295
Packhouse 4	240
Packhouse 5	235
Packhouse 6	210
Packhouse 7	230
Packhouse 8	220

percentage varied from (26.23%) Packhouse 4 to (37.6%) from packhouse 3 over the period of 10 days. As per APEDA 2023–24, a total of 26,79,50,400 kg of grapes was exported to various nations. Sharma *et al.* (2018) estimated 71% of the grapes produced are suitable for table use, while the remaining 27% are dried and used to make raisins, 1.5% is used to make wine, and 0.5% are used to make juice. Dwyer *et al.,* (2014) stated that during the wine-making process, about 25% of the weight of the grapes is lost or produced as byproducts. The skins and seeds make up "pomace," as this trash is known. Most of the pomace is currently composted and then returned into the vineyards to complete the carbon cycle.

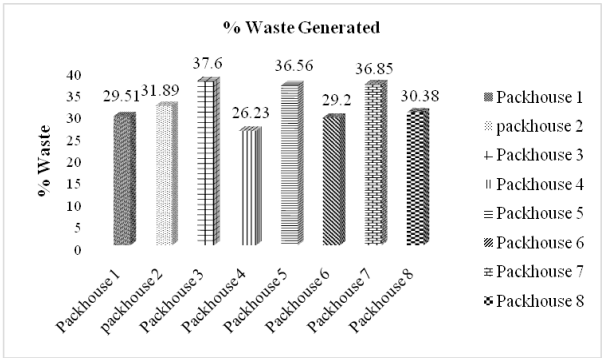

Fig. 4. % Waste generated from packhouses

Utilization of Grape waste

It is evident from looking at Fig 5. data was collected during a 10-day period from 8 different packhouses. It is also noted that the discarded grapes are divided into categories: raisins, animal feed (44%) and vinery (6%). Additionally, only three enterprises send their waste grapes to vineyards; it is estimated that these vineyards receive between 1500 and 2000 kg of grapes every day. The grapes from the other five industries are used to make raisins, with the leftovers being fed to animals the results were same in findings with Sharma *et al.* (2018) stated that the Workers across the nation have reported postharvest losses in grapes ranging from 8.23 to 16%. India is now losing over 223 thousand tonnes of grapes annually, based on an estimate of 8.23%. The loss is

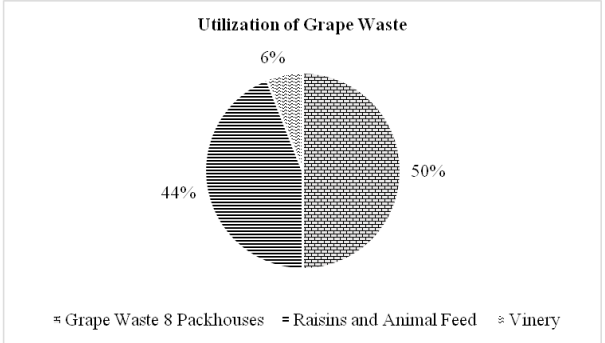

Fig. 5. Utilization of grape waste

significantly larger than anticipated if it is computed as economic loss (rather than just visible loss). Owing to the fragility and high perishability of grapes, there can be significant losses incurred in the preparation, harvesting, packaging, storing, transportation, and distribution of table grapes. Nistor *et al.* (2014) explained the use of grape pomace on milk yield and milk composition in dairy cattle

CONCLUSION

- The pack houses that are functioning for long years has better waste utilization management than recent ones.
- During transportation of grapes from farm to pack house, four packhouses shows more damage occurred in those crates that were not lined with bubble sheet.
- Different industries produce different by-products that are utilized as NPD (new product development) 58%, Animal feed 21% and Manure 21%.
- Waste generated from all the 8 pack houses varied from 26.23% (Pack house 4) to 37.6% (Pack house 3).

The different packhouses utilize their waste as raisins and animal feed (44%) and vinery (6%).

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