

Understanding Perceptions Regarding Availability, Quality, Status and Methods Used in Storing Fruits and Vegetables in Pakistan's Dera Ismail Khan District

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Abstract

This paper presents the results of a survey on the situation of farmers, their problems and feasibility of heat stress techniques during storage of fruits and vegetables in Pakistan. In addition, consumer perception was also surveyed regarding availability and quality of stored fruits and vegetables. The survey, which was conducted at Dera Ismail Khan District of Pakistan's North West Frontier Province during 2004, revealed that most of the farmers sell all their produce in the market just after harvest. This might be either due to the unavailability of storage facilities or the high cost to store low and medium value fruits/vegetables. High electricity costs and frequent power cuts further raised the storage prices. However, among different methods practiced locally, sun drying was the most popular method. Regarding consumer perception, the majority were not satisfied about availability of fruits and vegetables in the market all the year round. Lack of storage facilities, damages that occurred during transportation, improper packaging, the role of middlemen, and huge influx of produce in a short time were the major reasons given for reducing availability of fruits and vegetables to consumers on the one hand and lowering returns to growers on the other. The growers demanded subsidized governmental storage facilities to store their agricultural commodities.

Discipline: Postharvest technology

Additional key words: agricultural commodities, consumer perception, consumption, production

Introduction

Nature has bestowed on Pakistan a land and climate conducive to growth of a wide spectrum of fruits and vegetables. The climate is characterized by well-defined seasons; winter (December–February), spring (March–April), summer (May–September), and autumn (October–November). During summer, in central and southern parts of the country, the temperature may go as high as 45°C. However, the northern regions have very pleasant weather during summer. Although only 4% of the country's cultivated area is devoted to fruit and vegetable cultivation, nevertheless, Pakistan produces all sorts of high

quality fruits and vegetables round the year. The annual production of fruits and vegetables in the country is more than 10 million t but due to inadequate post-production handling and non-availability of proper storage, almost 50% of the total production is wasted which shrinks the eventual supply and puts pressure on prices¹.

Pakistan exports many fruits and vegetables to various countries, mainly in the Middle East, Far East and Europe. During 2002–2003, Pakistan annually produced 1.702 million t of citrus, 1.03 million t of mango, 0.31 million t of apple, 0.62 million t of dates, and 0.53 million t of guava. This virtually makes Pakistan one of the largest citrus producing countries of the world^{1,24}. At present, the country has only a limited export market for

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mangoes to mainly the Gulf States, the United Kingdom and Afghanistan⁷. During 2002–2003, Pakistan annually exported 100,000 t of dates to Canada, USA, Germany, UK, Denmark, Australia, India, Bangladesh, Nepal, Sri Lanka, South Africa, UAE, Japan, China, South Korea, and North Korea. It is ranked second among the date exporting countries of the world. Furthermore, during 2003–2004, Japan annually imported fruits and vegetables from Pakistan worth of 114,000 US\$ (fruits; 90,000 US\$ and vegetables 24,000 US\$).

Dera Ismail Khan is the extreme southern district of the North West Frontier Province (NWFP) of Pakistan and lies 31° 49' N latitude and 70° 55' E longitude. It has a total geographical area of about 1 million ha, out of which only 0.308 million ha are under cultivation² (18.31% is under crops whereas 15.53% is not available for cultivation). The total irrigated area of Dera Ismail Khan is about 14.73% with arid to semi-arid climate. It is hot and dry in summer with moderate spells during the monsoon season. The elevation ranges from 121 to 210 m above sea level. The mean maximum temperature in summer and winter is 45°C and 8°C, respectively. The mean annual precipitation ranges from 15–25 cm and relative humidity varies from 51% in June to 78% in October. The area is recognized for the production of all major crops, fruits and vegetables. During 2002–2003, annual production of 288 t of apple, 582 t of banana, 2,502 t of chillies, 4,002 t of dates, 3,119 t of guava, 1,936 t of mango, and 1,185 t of onion was noted in this part of the country².

Despite the very favorable environmental conditions for fruit production with fruits of attractive flavour and aroma, fruit exports have been insignificant, representing only 4.25% of the total production. At present, total exports of fruits, vegetables and fish from Pakistan annually are a little over \$200 million. According to an estimate, Pakistan loses fresh food items worth Rs.50 billion (close to 1 billion US\$) every year because of non-availability of proper food preservation facilities¹. One of the major reasons is a lack of storage and canning facilities. The existing fruit and vegetable processing industry is concentrated in big cities and industrial zones with tax and duty exemptions while their raw material is produced in distant areas of the country. Only 25 firms are engaged in canning, preservation and bottling of fruit juices. These installations have an annual capacity of processing about 3,000 t of fruit into squashes, jams, jellies, and pickles, while the country's total annual production is 5 million t of fruits and 4 million t of vegetables¹⁵.

Variations in temperatures at docks, and during storage and transportation stages result in damaging the fruit. It is estimated that 25% of fruits and vegetables go to

waste during harvesting, transportation, packaging, and storage²⁴. If only half of the wastage could be avoided, the country would earn an extra Rs.200–300 millions of foreign exchange annually by exporting these agricultural commodities. There is a need for some good storage techniques to prevent the waste of fresh fruits and vegetables during storage. These techniques should depend on a minimal power supply and be easy to adopt.

The present study was, therefore, undertaken to evaluate the perceptions of fruit and vegetable growers about status, problems and prospects of storage techniques and to assess the consumer perception about stored farm commodities.

Materials and methods

To probe into the objectives of the present research, growers' and consumers' perspectives in defining their concerns in storage of fruits and vegetables were investigated. This is because most of the previous studies and projects mainly focused on developing storage structures but had not taken the views of the stakeholders into account. Keeping this in view, a fruitful effort has been made to actually analyze the situation of farmers and problems encountered during storage. In this context, a survey was conducted to find out problems in storage of fruits and vegetables and feasibility of heat stress techniques, their application and profitability to the local market. The research project was based on interviews with 90 respondents (30 fruit growers, 30 vegetable growers and 30 consumers) in Dera Ismail Khan District of Pakistan. The respondents who were included in the final interview schedule were selected on the basis of their acreage (having 5 a or more under fruit and vegetable cultivation). The sample size was determined by using a simple random sampling procedure of probability sampling. A sampling frame was developed that carried details of farmers actively involved in fruit and vegetable production. This was identified by collecting information from the key informants. The data were recorded and tabulated across respondents for comparison, using the SPSS computer software package. The contents of the questionnaire are presented as follows.

Main contents of questionnaire for growers

1. What fruits/vegetables do you cultivate?
2. What storage facilities do you use for storing fruits/vegetables?
3. Are there any problems/deterioration in storage methods you use?
4. Are you satisfied with the storage facility you use for fruits/vegetables?

5. Do they extend shelf life of fruits/vegetables?
6. Are there any problems in fruits/vegetables after storage?
7. What kind of qualities do you want in a good storage method?
8. Do you get any losses during transportation of fruits/vegetables?
Can you name them?
9. Do you think that there is enough supply of fruits/vegetables in the market?
If NO, where do most of the fruits/vegetables go after harvest (who mostly uses them)?

Main contents of questionnaire for consumers

1. Do you find enough supply of fruits/vegetables in the market?
If NO, where do you think do most of the fruits/vegetables go?
2. Are you satisfied with the quality of fruits/vegetables available in the market?
If NO, what are the problems?
Why do fruits/vegetables have these problems?
3. Are you satisfied with the stored fruits/vegetables?
If NO, what are the reasons?
4. What should be done to overcome the problems associated with lack of availability/quality of fruits and vegetables?

Results and discussion

1. Growers' perspective

(1) Fruits and vegetables grown in the area

The climate and soil conditions of the area support the production of mango, guava and date fruit. Survey results revealed that farmers were growing a number of fruits. However, a majority of them were inclined towards growing mango (93%), followed by guava (80%), dates (70%), and lemon (40%) fruit (Fig. 1). Similarly, major vegetables grown in the area were spinach (80%), cauliflower (83%), sponge gourd (67%), tomato (70%), pumpkin, bitter-gourd (67%), summer squash (99%), and ladies' fingers (60%) as shown in Fig. 2.

(2) Method used, perception of problems and satisfaction from storage method used

Due to the unavailability and lack of technical know-how in storing fruits, most of the farmers sell all their fruits (63%) in the market just after harvest to avoid any deterioration and financial loss. However, among different methods practiced locally, sun drying is the most popular method of fruit storage as reported by 60% of the contacted growers (Fig. 3). Very few growers are also using "juice preservation" (13%) and wooden car-

tons (3%) for the storage of their fruits. Since farmers are lacking storage structures, open air-drying (sun drying) is often associated with weather damage (rain, unfavorable temperatures, and strong hot and desiccating winds) as the principal problem reported by nearly half of the sampled growers. Growers are either dissatisfied (37%) or very little satisfied (53%) when it comes to satisfaction with already available and practiced storage techniques (Fig. 4). Similar to fruits, most of the growers sell all

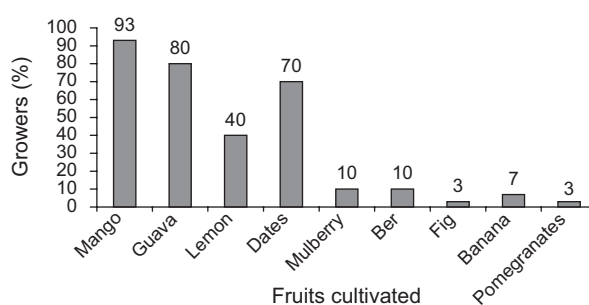


Fig. 1. Percent of growers cultivating fruits in sampled areas

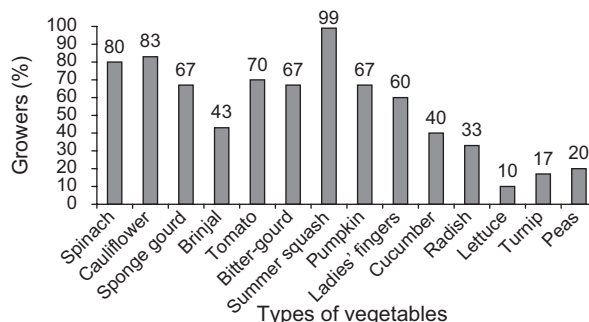


Fig. 2. Percent of growers cultivating types of vegetables in sampled areas

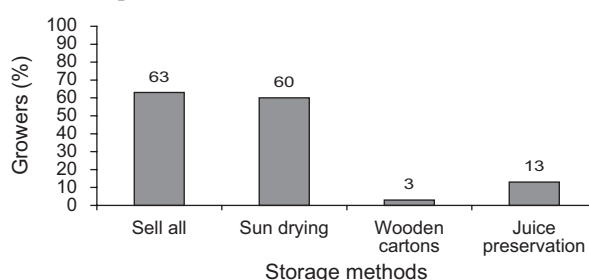


Fig. 3. Percent of growers using fruit storage methods in sampled areas

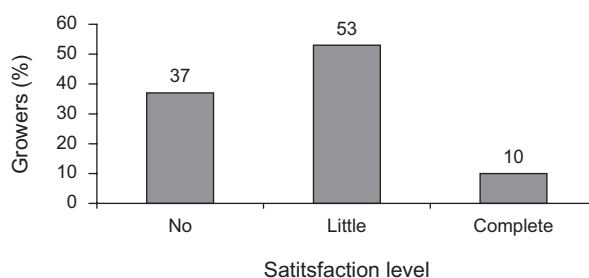


Fig. 4. Percent of growers satisfied with storage methods used for fruits in sampled areas

their vegetables (77%) immediately after harvesting due to unavailability of proper storage facilities. However, only a small number of growers (23%) opted for storage of vegetables by sun drying method (Fig. 5). A majority of the vegetable growers (97%) of the sampled population were dissatisfied with the available storage techniques while only 3% showed their satisfaction to some extent (Fig. 6).

(3) Deteriorations in storage method used

It has been observed from the data that a majority of growers mentioned deterioration in fruits when stored. The major factors quoted were the presence of insect pests (83%) followed by post-harvest diseases (40%) that resulted in rotten, bad flavoured and inferior quality fruits (Fig. 7).

(4) Growers' perceptions of the characteristics and demand for storage techniques

Regarding perception of the desirable characteristics for a storage method, growers mostly expect to advanced

storage methods. They were looking for a solid, ventilated storage structure (63%) equipped with scientific mechanism (43%) in order to avoid any damages (Fig. 8). Availability of cold storage structures (83%) were highly demanded by the fruit growers (Fig. 9), so that their precious commodities could be kept properly and ultimately fetch high premiums in the market. Likewise, the vegetable growers were also looking for a storage place, which should be solid, ventilated (87%), clean (13%) and free from insect pests and rodents (3%) to avoid any damage (Fig. 10). They strongly demanded cold storage facilities (77%) and 23% of the respondents were interested in subsidized government storage facilities (Fig. 11).

2. Consumers' perspective

(1) Perceptions of the availability of fruits and vegetables

Most of the consumers (60%) reported that fruits and vegetables were not available in abundance (Fig. 12). This has been attributed to a number of reasons. The

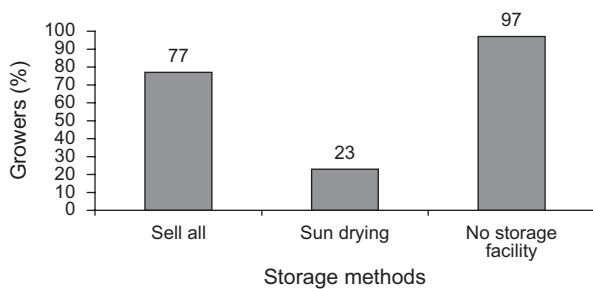


Fig. 5. Percent of growers using storage methods for vegetables in sampled areas

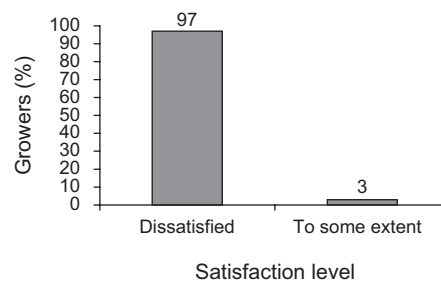


Fig. 6. Percent of growers satisfied with storage method used for vegetables in sampled areas

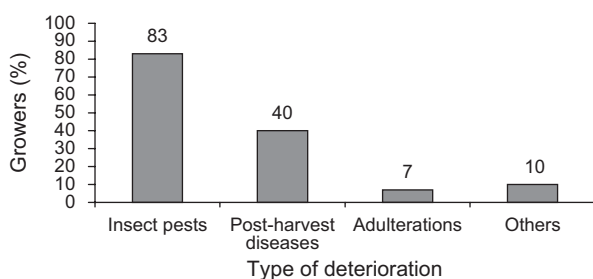


Fig. 7. Percent of growers citing types of deterioration during fruit storage in sampled areas

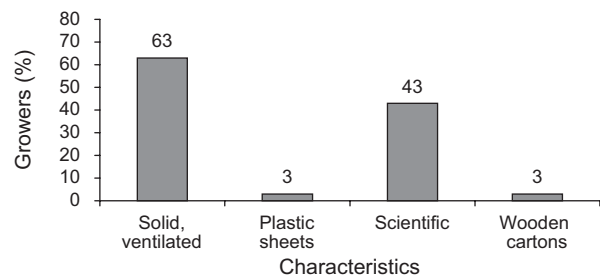


Fig. 8. Percent of growers citing characteristics of good quality fruit storage

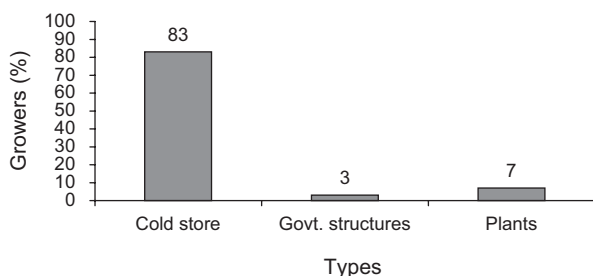


Fig. 9. Percent of growers demanding types of fruit storage facilities in sampled areas

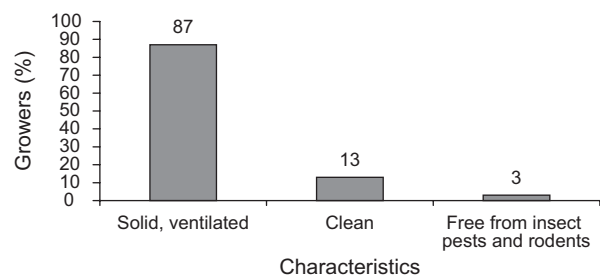


Fig. 10. Percent of growers citing characteristics for good quality storage of vegetables

prime factor was the absence of storage facilities (70%), followed by damages that occurred during transportation (45%). As shown in Fig. 13, the other grounds for limited availability of fruits and vegetables were improper packaging (11%), the role of middlemen (15%) and huge influx of produce in a short time (35%) which resulted in wastage of most fruits and vegetables and thus reduced their availability to consumers on the one hand and lowering returns to growers on the other.

(2) Satisfaction and problems in storage method used

About half of the contacted consumers were dissatisfied with the available methods used by the growers in storing their fruits and vegetables (Fig. 14). It was

because of the prevalence of problems in storage. The major problems were lack of proper storage structures (51%) and appropriate knowledge (40%) in storing fruits and vegetables (Fig. 15). The other problems mentioned were lack of use of improved methods in cultivation (30%) and adulteration (25%).

(3) Availability of low-priced fruits and vegetables

A majority of the surveyed population (63%) perceived that most of the times, fruits and vegetables were not selling as low-priced commodities (Fig. 16). It was due to not using proper storage methods that caused lots of wastage of fruits and vegetables and eventually resulted in their availability in low quantity, thereby

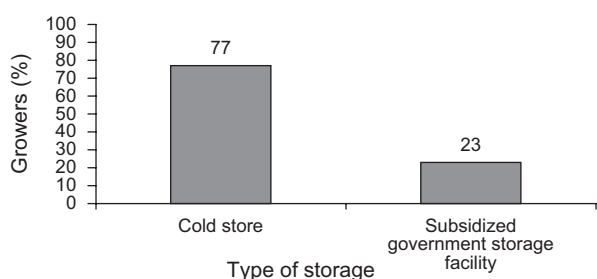


Fig. 11. Percent of growers demanding a type of storage facility for vegetables in sampled areas

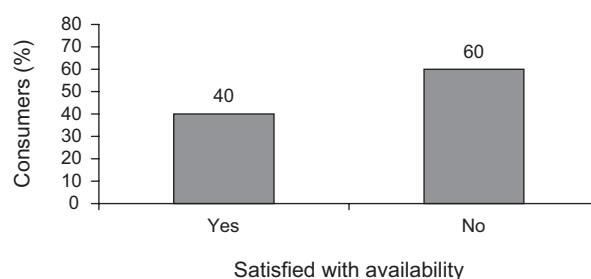


Fig. 12. Percent of consumers satisfied with availability of fruits and vegetables

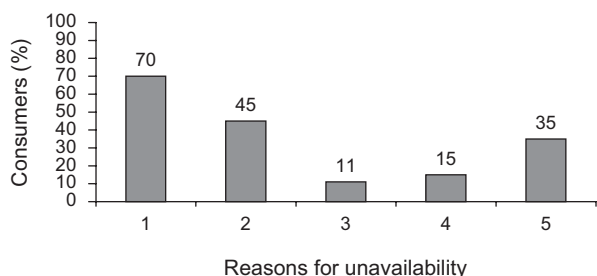


Fig. 13. Percent of consumers citing reasons for unavailability of fruits and vegetables

1: Absence of storage facilities, 2: Damages during transportation, 3: Improper packaging, 4: Role of middlemen, 5: Huge influx of produce in a short time.

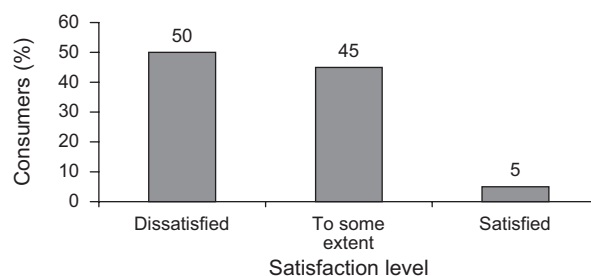


Fig. 14. Percent of consumers satisfied with storage methods used for fruits and vegetables

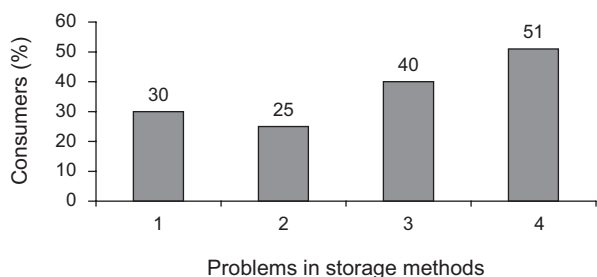


Fig. 15. Percent of consumers citing problems in storage methods used

1: Lack of improved methods in cultivation and harvesting, 2: Adulteration, 3: Lack of knowledge, 4: Lack of proper storage structures.

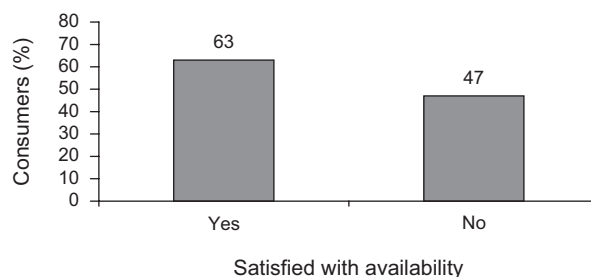


Fig. 16. Percent of consumers satisfied with availability of low-priced fruits and vegetables

increasing prices based on the rationale of demand and supply. The other vital reason for increased prices of fruits and vegetables was the high cost of transportation (51%), followed by transportation of good quality produce to other areas (45%) where growers can fetch high profits (Fig. 17).

(4) Satisfaction with the quality of fruits and vegetables

A sizeable portion of the consumer community was either dissatisfied (35%) or satisfied to a very limited extent (55%) regarding the quality of available fruits and vegetables (Fig. 18). Their perceptions were expressed in citing a number of undesirable changes in fruits and vegetables during storage (Fig. 19). The most common reason was quick deterioration of purchased produce at room temperature (53%), followed by changes in flavor (40%), color (35%) and abnormal softening (20%).

3. Suggestions for improvement

Regarding suggestions for improvement in quality of fruits and vegetables and their availability, consumers stated a need for proper storage methods and structures (60%), followed by off-season cultivation (43%) as shown in Fig. 20.

Summer is very hot in Pakistan. The temperature during summer months (May–August) ranges from 40–50°C. It is, therefore, very important to utilize the solar energy and extend the shelf life of fresh fruits and vegetables, especially, during the summer season. Previously, solar-drying technology has successfully been applied for the preservation of apricots and dates in the country, using flat plate solar collectors, fan and a drying chamber. About 20–60% moisture is reduced in about 5 days whereas the conventional sun drying method takes 10–15 days. It is a major problem that when fruits and vegetables glut the market, they fetch very low prices in most parts of the country. Whereas, the consumers have to face acute shortages accompanied with high prices manifold during the off-season.

A heat stress application technique that can maintain the freshness of the fruit during long term storage has been developed in recent years^{5,19,20,23}. It has been reported that applying heat stress of 40–50°C for 12–14 h at the first stage of the storage process could reduce the water loss of the fruit during storage^{21–23}. In a country characterized by high temperature, it is easy to apply pre-storage heat stress to fruits and vegetables to retain fresh-

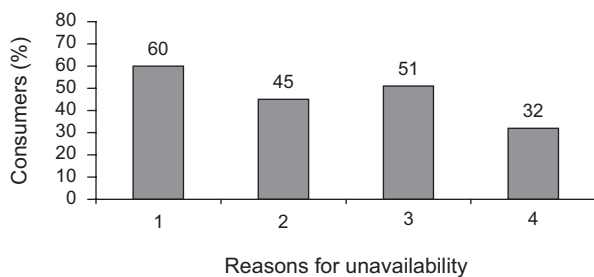


Fig. 17. Percent of consumers citing reasons for unavailability of low-priced fruits and vegetables
 1: Improper storage, 2: Transport of good quality fruits and vegetables to other areas, 3: High cost of transportation, 4: Cultivation on less area and transportation to areas of high returns.

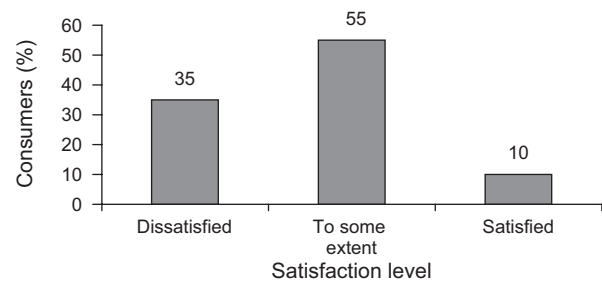


Fig. 18. Percent of consumers satisfied with the quality of stored fruits and vegetables

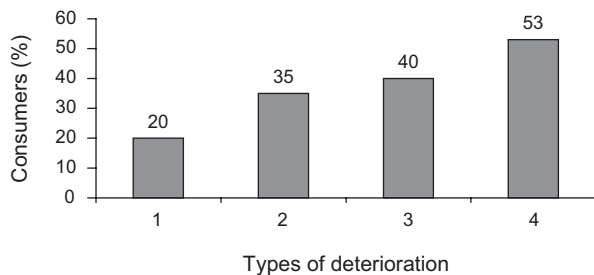


Fig. 19. Percent of consumers citing types of deterioration during storage of fruits and vegetables
 1: Abnormal softening of fruits and vegetables, 2: Changes in color, 3: Changes in flavor, 4: Quick deteriorations at room temperatures.

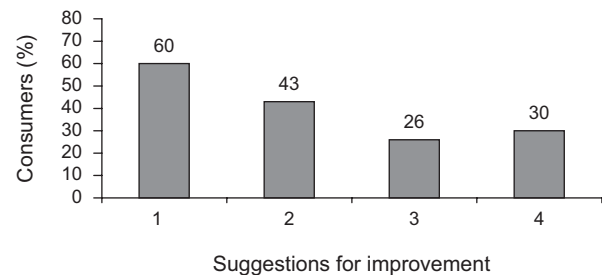


Fig. 20. Percent of consumers citing suggestions for improvement of storage and quality of fruits and vegetables
 1: Need for proper storage methods and structures, 2: Off-season cultivation, 3: Use of plastic tunnels in winter, 4: Support prices and legislation.

ness longer during storage¹². Moreover, this technique is very effective for inhibiting ethylene production^{13,18}, controlling insect pests and reducing chilling injury^{13,14}. In addition, the quality of fruit does not deteriorate but is improved considerably^{8,29}. Post-harvest exposure to heat stress (40–42°C) often increases storage life and improves the flavor of a number of fruits²⁹. It has also been investigated that the thermal treatment methods, especially hot air, are very helpful in maintaining the freshness of fruits during storage, so this technique can be used in tropical (hot) areas such as Pakistan.

Establishment of cold storage for the preservation of fruits and vegetables involves not only huge initial investment and infrastructure but is also less feasible under many circumstances. Whereas, in recent years, the heat treatment techniques (placing under hot water and hot air for a specific time before storage) have successfully been applied to a number of fruit and vegetable storage processes including apple^{25,31}, banana³, cherry²⁶, mangoes^{9,16,28}, peaches¹⁰, orange^{17,19,20}, tomato^{5,19,20,23}, potato⁶, and grapefruit³⁰. This is probably due to the production of heat shock proteins in the living tissues, which led to a reduction in water loss during storage^{4,11,27}. Keeping in view, the proposed heat treatment technique will not only help farmers and industry in utilizing over or surplus production during the peak harvest season but also help in stabilizing prices during harvest and off-season.

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