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Demonstration of Technologies and Training of Growers for Handling and Value Addition of Fruits and Vegetables in Gilgit-Baltistan

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ABSTRACT

Introduction

The present activity was conducted to execute fruit handling, processing, preservation, dehydration and value addition trainings in Gilgit-Baltistan, to control wastages/losses of fruits and vegetable which is above 60% of total production.

Objectives

To prepare fruit pulp for fruit preservation using potassium metabisulphite ($K_2O_5S_2$). To develop household level methods for development of value added products like fruit jam, tomato paste, mix vegetable pickle and dehydrated apricot.

Methods

The research work for method development was carried out at Pakistan Council of Scientific & Industrial Research (PCSIR) Skardu, Gilgit-Baltistan, Pakistan. Methods were developed with recommended dosages of chemical preservatives. A total of two days training courses were conducted focusing fruit handling, processing, preservation, dehydration and value addition of fruits and vegetables at 4 different locations in 4 districts of Gilgit-Baltistan (Skardu, Diamer, Hunza and Shigar).

Results

In each district, 4 training courses were conducted at 4 different locations and in each training there were 30 participants. The participants included fruit growers/farmers. A total of 480 fruit growers were trained in all the 16 training courses in 4 districts. The farmers also trained in use of fruit processing machinery as pulpier, washer, cutter, etc.

Conclusion

The basic objectives of training were to control wastages/losses of fruits, income generation of fruit growers through sale of fruit, value added products and to contribute to ensure food security issue in Gilgit-Baltistan.

Keywords

Trainings; Value addition; Fruits; Vegetables; Wastage; Gilgit-Baltistan.

INTRODUCTION

Gilgit-Baltistan (GB) is one of the most important parts of Pakistan (geographically it is connected with China and India) which extends over an area of 27,188 sq miles. Administratively, Gilgit-Baltistan is distributed into 10 Districts (Gilgit, Skardu, Diamer, Astore, Ghanche, Ghizer, Hunza, Nagar, Shigar and Kharmang) having a population of 2 million people. The main issue in Gilgit-Baltistan is food security, as cultivated lands are less than one kanal per capita.[1,2] The people of GB are totally dependent on wheat supplied through Government on subsidized rates from Punjab.[3,4] The climatic conditions of GB are suitable for abundant, delicious, high-quality fruits and vegetables. Fruits and vegetables are the main source of income generation for the area. According to agriculture statistics 2014,[5] the pre- and post-harvest losses of fruits and vegetables are 50% and according the survey of center for public health initiatives (CPHL) project PCSIR[6] these losses exceed 60% of produce. The total fruit production in GB

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is 1,49,769 metric tons (Apricot 1,08,588 tons, Apple 19,054 tons, Grapes 6,413 tons, Pear 2,579 tons, Peach 3,308 tons, Pomegranate 4,287 tons, Cherry 2,256 tons, Mulberry 9,092 tons, Walnut 5,992 tons, Almond 1,700 tons and Sea buckthorn 3,600 tons). Due to lack of processing, preservation, testing, transportation, communication and research a large amount of fruits, vegetables are wasted and do not reach the markets as the fruits are highly perishable. To cope with growing demand of fruits and vegetables without bringing more land under cultivation, prevention of post-harvest losses can play a vital role. Training farming community in processing, preservation, dehydration and value addition of fruits and vegetables can control post-harvest losses.[7,8]

Demand of chemically preserved fruit pulp and semi-processed fruits is on the rise among the food industry of Pakistan. Demand has also risen for dehydrated fruit, pulp and other value-added products in the western market. A number of importers from Europe have shown their interest in the import of dry apricot from Gilgit-Baltistan.[9] According to Baltistan Culture Development Foundation (BCDF) Skardu, Gilgit-Baltistan, Pakistan there was an order of 3,500 tons dried apricot from a single party from the United Kingdom during the year 2014, but they failed to collect 10 tons of dehydrated dry apricot of international standard. This project aims to address this issue through training of selected progressive farmers of 4 districts of GB which will be extended to all 10 districts. The training sessions will enable farmers to process their products according to Hazard analysis and critical control point (HACCP), World Health Organization (WHO) and Food and Agriculture Organization (FAO) recommended standards, with recommended chemical preservatives/doses and to produce quality value-added products in accordance with international requirements. This would not only help to uplift the socio-economic conditions of the farmers but help to cater local and international demands.

For export of value-added fruit products, each product must contain its nutritional profile amounts of preservatives, expiration date and testing/analysis certificate from any ISO17025 certified accredited laboratory. The project will address this issue with purchase of the required laboratory testing equipment through this project. Sometimes, even the hygienic and best quality fruits/value-added products are rejected during export due to inappropriate packaging material, large in volume and weight, unattractive and without required printed information in packaging material. Packaging machines were used to train the farmers, the training included packaging that is recommended, attractive, low in volume/size and with required information supplied in the packing materials.

In order to minimize these post-harvest losses of fruits and vegetables, PCSIR established a Demonstration-Cum Training Center in Skardu, Gilgit-Baltistan, Pakistan which is equipped with processing and testing/analysis, qualified and skilled scientist/food technologists. Now PCSIR Demonstration-Cum Training Center Skardu has been upgraded to PCSIR Laboratories Skardu. It has been providing processing, testing and research facilities in Gilgit-Baltistan. Fruits and vegetables processing training provided to farmers during the past few years have yielded excellent results.

Pakistan Council of Scientific & Industrial Research (PCSIR)Skardu has also been extending the expertise of their scientists, processing and Lab. facilities to the other allied departments and Non-Government Organizations (NGOs)such as, Agha Khan Rural Support Program (AKRSP),Mountain Areas Farmer Support Organization(MAFSO), Ghizer Women Development Social Welfare Organization (GWDSWO), Agribusiness Support Fund (ASF), Baltistan Cultural Development Foundation (BCDF) and Agriculture Department to conduct fruit and vegetable dehydration and preservation training at Demonstration Cum Training Center Skardu, Gilgit-Baltistan, Pakistan.

To realize the need of processing of fruits and vegetables, Karakoram International University (KIU) started BSc (Hons) and MSc (Hons) degree programs at Department of Agriculture and Food Technology, Gilgit where students are educated/trained about processing of fruits. The processing training for the majority of farmers needs to be given in the future to control the existing losses/wastages of fruits though skill development in processing. The PCSIR, Skardu needs financial support to conduct processing, preservation, dehydration and value addition of fruits and vegetables training throughout the Gilgit-Baltistan (all 10 Districts) and to procure some essential Lab. equipment. Therefore, a proposal for these endeavors has been submitted to Agriculture Linkage Program (ALP) Pakistan Agriculture Research Council (PARC), Islamabad.

MATERIALS AND METHODS

Fruits and vegetables (i.e. apple, tomato, apricot and cabbage leaves) were purchased and different trials took place to develop household-level value-added products. The most liked formulas were determined through an organoleptical evaluation panel of PCSIR experts and selected for the compilation of a Fruit Processing Booklet (mentioned by Larmond E). During these initial trials, the pulp was preserved at the recommended dosage of potassium metabisulphite ($K_2O_5S_2$), i.e. 1 gram for 1 litter pulp.[10] Tomato paste was prepared from over-ripened tomatoes, apricot dehydration was done without chemical preservatives and with chemical preservatives, and for vegetable pickle household level methods were developed.[11] These methods were compiled in the form of a fruit processing booklet entitled "*Processing, Preservation, Dehydration and Value Addition.*"

The physicochemical analysis of developed jam, pulp and tomato paste was carried out such as pH, total soluble solids, acidity (%), sugar acid ratio, Brix, reducing sugar, and non-reducing sugar using the recommended methods of Association of Analytical Communities (AOAC).[12] The same samples were organoleptically evaluated for color, taste and overall acceptability by a panel of 10 experienced judges using Nine Point Hedonic Scale (as described by Larmond). After printing of the booklet, other required items for fruit processing training were purchased from the local market i.e. fruit processing chemicals (potassium metabisulphite, citric acid and pectin), head covers,

facemasks, disposable gloves, pen, writing pads, etc. The training were conducted in collaboration with Agriculture Department of concerned district, while in some locations the training was conducted with Local Support Organizations (LSO) and Welfare Organizations (WOs). Before the start of training, Memorandum of Understandings (MoUs) were signed with the collaborating partners.

Fruit Processing Training

Two days fruit handling, processing, preservation and value addition training started from District Diamer, Gilgit-Baltistan. The principal investigator and his team including the female training facilitator, along with mobile training unit and its operator proceeded to district Diamer from PCSIR Laboratories, Skardu. Training material i.e. apples, tomatoes, vegetables, spices for pickle were purchased and the training started from the first location "Chilas" of district Diamer. First day of training started at 9:00 am. Registration of trainees started, a folder consisting of two days training schedule, writing pad, pen, fruit processing booklet, facemask, head cover, disposable gloves and a list of contacts of fruit processors in GB were given to each trainee. Then Deputy Director, Agriculture Department District Diamer delivered a welcome address and brief about the agricultural scenario of the District, after that the Principal Investigator briefed about the objectives of fruit processing training. Then practical training on development of apple pulp at household level started.

Development of Apple Pulp and its Preservation

Initially, 10 kg apples were taken, washed and cut it into pieces, poured in 5 liters of water and started cooking. After proper cooking, removed the steel pan from stove and allowed to cool for 10 minutes. Then filtered the cooked apples with muslin cloth pressed by hand. The received pulp was weighed and according to weight, added 1 gram potassium metabisulphite per liter pulp i.e. 1000 ppm (Awan and Rehman).[13] After proper mixing, the pulp was packed in 1 litter sterilized bottles.

Preparation of Fruit Jam

The second practical for the first day of training was preparation of fruit jam at household level. A 5 liter preserved apple pulp was put into a stainless steel pan and started cooking; then added sugar (550 g/liter pulp), citric acid (4 grams/liter pulp), pectin (5 grams/liter pulp) and mixed thoroughly. The mixture cooked until the required brix (68 ºBrix). The jam was allowed to cool for 5 to 10 minutes to lower the temperature almost below 85 ºC, that protects glass jars from burst with high temperature and packed in sterilized glass jars, capped and labeled (Awan and Rehman).[13]

Preparation of Tomato Paste

Tomatoes were washed, cut into pieces, and pulp extracted using the pulpier machine fitted in the mobile training unit (MTU). The pulp was weighed and put it into a cooking pan and started cooking until 50 ºBrix was reached (checked with digital refractrometer). After that, added salt (5 g/liter), vinegar (5 g/liter) and 1 g potassium metabisulphite.[10] Removed the fire, cooled the paste and packed into bottles.

Preparation of Vegetable Pickle

The second day started with practical preparation of vegetable pickle. Cabbage leaves were washed, cut into pieces and put into a cooking pan to start cooking. Added salt 25 g/kg after slight cooking; drained water and put leaves in perforated trays to dry. Then add dry red chili powder (10 g/kg), mustard seed (10 g/kg), coriander seed (8 g/kg) and mixed mustered oil up to lid of jar. Finally, mixed it properly and filled in glass jars and capped.[13]

Dehydration of Apricot

The second practical of day 2 was dehydration of apricot. Fruit growers of the area were trained in dehydration of apricot. Apricot Variety "Halman" which is best for dehydration was used. Two methods i.e., organic dehydration and inorganic dehydration were utilized.[14]

Organic Dehydration

Apricots harvested from tree were washed and pitted (kernels of apricot removed). The de-pitted apricots were kept in wooden trays and kept in open sun for dehydration. On clear, sunny days dehydration is completed within 6 days. The dehydrated apricots were cooled before packing in polyethylene bags and sealed.

Inorganic Dehydration

In inorganic dehydration, the solution of potassium metabisulphite (2 g/liter of water) was prepared. The apricots were de-pitted and dipped in this solution for 10 minutes, then the apricots were kept in wooden trays and kept in the open sun for dehydration.

Physicochemical Analysis

The physicochemical analysis of the jam, tomato paste, vegetable pickle, and dehydrated apricot was carried out, such as pH, total soluble solids, acidity (%), sugar acid ratio; reducing sugar and non-reducing sugar were carried out using the recommended methods of AOAC.[12] The samples organoleptical evaluation included for color, taste, and overall acceptability by trainees by using the Nine Point Hedonic Scale described by Larmond.[15]

Demonstration of Use of Fruit Processing Machinery

The Mobile Training Unit (MTU) was equipped with fruit pulpier, washer, cutter, mincer, potato peeler etc. Demonstration of fitted machines occurred during fruit processing training. The fruit growers practically performed use of these machines. The training process was performed on the same pattern for all 4 districts of GB.

RESULTS AND DISCUSSION

The methods developed for fruit jam, tomato paste, vegetable pickle and dehydration of apricot (organically and inorganically). The organoleptically recommended best methods were compiled and 1400 copies of fruit processing booklets were printed. The accepted formulae are shown in Table 1, the two days fruit handling, processing, preservation, dehydration and value addition training were given according to these methods/recipes.

Training on Fruit Processing

Conducted 16 training courses, each lasting 2 days, consisting of 491 fruit growers/farmers trained at fruit harvesting, handling processing, preservation, dehydration and value addition during the reporting year in 4 districts of Gilgit-Baltistan (Skardu, Diamer, Hunza and Shigar). The training were given to 16 groups at 16 different location, 4 groups/location in each district and one group consist of 30-36 participants (Table 2). All the required preservatives, processing chemicals, bottles, head covers, facemasks, gloves, pen, writing pads, training schedule, processing booklets and fruit survey questionnaires in Urdu were provided to the trainees in a folder. The fruit growers/farmers practically performed all the training activities to get hands-on training. The officials and trainees appreciated the material provided in the fruit processing booklet. All trainees participated with keen interest. After fruit processing and preservation training, it is expected that the fruit growers/farmers will preserve their fruits, and the wastage of fruits will be minimal and they are likely to get maximum benefits from their produce.

Fruit Value-added Product Development Training

The training were conducted at household level i.e. how to prepare these products using kitchen utensils' no additional utensil/equipment were purchased except fruit processing chemicals. The recommended methods/recipes/formulas were used for product development. The fruit growers/farmers practically performed this value-added product development. After practical training the chemicals were provided to each trainee from project (i.e. Potassium Metabisulphite 40 g, Citric Acid 30 g and Pectin 30 g) and given task to prepare Apple/Apricot jam at their homes at the evening of the first day of training. More than 58% training participants prepared Apple/Apricot Jam at their homes after receiving training using the provided chemicals. The list of trainees is shown in Table 3 developed jam at home after practical. The quality of developed jam was good but some training participants have not properly judged the time of removal of jam from stove. The 2nd day the jams prepared by trainees were examined by project team and the trainees were explained about the quality of their jam, their deficiency were identified and were advised how to eradicate them. The value-added products receive premium prices in local and international markets. Prolonged fruit shelf life will help in developing the cottage industry (small scale fruit processing industry) at the village level in Gilgit-Baltistan, which will be a new avenue of income generation and source of income generation for the mountain communities.

Dehydration of Apricot

Apricot dehydration training both organically and inorganically with recommended standards were given to 16 groups consist of 491 selected fruit growers in 4 districts. Dehydration of apricot was common and most of the farmers dehydrate their fruits but unfortunately they do not follow recommended methods, and dehydration occurs in a non-hygienic manner with banned methods and overdose of chemical preservatives.

During training it was noted that some farmers dehydrate their fruits with chemical preservatives (Potassium Metabisulphite) without any measurements and they have no idea about the recommended dosage. During training it was strictly told to the farmers about use of preservatives within recommended dosages (i.e. 1 g/kg of fruit). Some farmers/growers also preserve their fruits through smoke of raw Sulphur (a traditional practice of the area); it was stringently advised to avoid this practice. It was also noted during training that some fruit growers dehydrate their fruits on the roadside and other places and that they do not take care for the quality of product and hygiene of product or self-hygiene. In all training, lectures on product quality and hygiene was given and its importance was practically demonstrated i.e., to cover their head with head covers, use of facemask and gloves while working and the trainers advised that it protects you and the product.

Table 1. *Recommended Methods/Recipes for Development of Apple Jam, Tomato Paste and Vegetable Pickle at House Hold Level for Farmers/Fruit Growers*

Apple Jam		Tomato Paste		Vegetable Pickle	
Name of Ingredient	**Quantity**	**Name of Ingredient**	**Quantity**	**Name of Ingredient**	**Quantity**
Apple pulp	1 liter	Tomato pulp	1 liter	Cabbage leaves	1 kg
Sugar	550 g	Salt	5 g	Salt	30 g
Citric Acid	4 g	Vinegar	10ml	Red chili powder	10 g
Potassium metabisulphite	1 g	Potassium metabisulphite	1 g	Coriander seed	10 g
Pectin	5 g	-	-	Mustard seed	10 g
Food color	As desired	-	-	Nigella seed	10 g
-	-	-	-	Mustard oil	Up to cover

Table 2. *Two Days Fruit Processing, Preservation and Value Addition Trainings During 1st Year of Project*

Group	District	Location	Collaborating Partner	Date	Participants
1	Skardu	PCSIR Laboratory	Agriculture Department Skardu	13-14, Feb- 2018	30
2	Diamer	Agri. Nursery Chilas	Agriculture Department Diamer	19-20, Feb-2018	30
3	Diamer	Agri. Nursery Goner Farm	Agriculture Department Diamer	21-22, Feb-2018	30
4	Diamer	Agri. Nursery Tangir Juglot	Agriculture Department Diamer	23-24, Feb-2018	30
5	Diamer	Agri. Nursery Darel Gumari	Agriculture Department Diamer	25-26, Feb-2018	30
6	Hunza	Khana Abad Jamatkhana	Agriculture Department Hunza	10-11, May-2018	30
7	Hunza	Gulkin Community Center	Agriculture Department Hunza	12-13, May-2018	30
8	Hunza	Passu community Center	Agriculture Department Hunza	14-15, May-2018	30
9	Hunza	ShishkatJamatKhana	Agriculture Department Hunza	16-17, May-2018	30
10	Skardu	Tormik Community Center	LSO Tormik	18-19, July-2018	36
11	Skardu	Astana Grace Academy	Agriculture Department Skardu	20-21, July-2018	35
12	Skardu	Baghardu High School	Rang Yul Welfare Organization	23-24, July-2018	30
13	Shigar	Agri. Nursery Hasoopi	Agriculture Department Shigar	29-30, Aug-2018	30
14	Shigar	Agri. Nursery Choka	Agriculture Department Shigar	31-1, Sep-2018	30
15	Shigar	Makunja	Kisaan Cooperative Society Shigar	2-3, Sep-2018	30
16	Shigar	GulabPur	Agriculture Department Shigar	4-5, Sep-2018	30
Total Fruit Growers/Farmers Trained					491

Table 3. *Number of Training Participants Developed Fruit Jam at their Homes after Receiving*

G.#	District	Training Location	No of trainees Developed Apple jam at home	No of trainees Developed Apricot Jam at home	Date	No of Trainees	%age
1	Skardu	PCSIR Laboratory	12	-	13-Feb-2018	30	40%
2	Diamer	Agri. Nursery Chilas	8	-	19-Feb-2018	30	26.6
3	Diamer	Agri. Nursery Goner farm	-	14	21-Feb-2018	30	46.6
4	Diamer	Agri. Nursery Tangir Juglot	10	-	23-Feb-2018	30	33.3
5	Diamer	Agri. Nursery Darel Guma	14	-	25-Feb-2018	30	46.6
6	Hunza	KhanaAbaridJamatkhana	17	-	10-May-2018	30	56.6
7	Hunza	Gulkin Community Center	20	-	12-May-2018	30	66.6
8	Hunza	Passu community Center	15	-	14-May-2018	30	50
9	Hunza	ShishkatJamatKhana	8	-	16-May-2018	30	26.6
10	Skardu	Tormik Community Center	22	-	18-July-2018	36	61.1
11	Skardu	Astana Grace Academy	-	25	20-July-2018	35	71.4
12	Skardu	Baghardu High School	-	23	23-July-2018	30	76.6
13	Shigar	Agri. Nursery Hasoopi	-	27	29-Aug-2018	30	90
14	Shigar	Agri. Nursery Choka	24	-	1-Sep-2018	30	80
15	Shigar	Makunja	26	-	2-Sep-2018	30	86.6
16	Shigar	GulabPur	20	-	4-Sep-2018	30	66.6
		Total	196	89		491	58.04

Demonstration Use of Fruit Processing Machinery

The participants were trained on use of fruit processing machinery for fruit pulp extraction, fruit/vegetable peelings, fruit crushing, chips cutting machinery, fitted on Mobile Training Unit (MTU). Skill development on the use of fruit processing machinery will be helpful in processing and preservation of fruits at commercial scale and in developing processing industry at Gilgit-Baltistan level. The farmers appreciated and took keen interest in the use of machinery. In some training locations, there was no road access for MTU; hence demonstration of commercial-scale machinery fitted in MTU could be performed.

CONCLUSION

The findings of these training activities showed that fruit processing training are likely to help control wastages/losses of fruits and vegetables. Value addition of fruits is expected to become a source of income generation so that the growers can get maximum benefits of their fruits/produce. Ultimately, this will

become a step towards self-sufficiency of the people of Gilgit-Baltistan. Skill development in use of fruit processing machinery will lead towards the establishment of fruit processing industry in GB.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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