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Research Article

Minimizing Post- Harvest Losses of Tomato through Demonstration of Preparation Techniques of Processed Tomato Paste to Small Scale Users in Tigray, Ethiopia

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ABSTRACT

During production peak, oversupply of fresh tomatoes in the market can be observed and price is much lower than during lean periods (summer season). Vegetable processing is a new vision for farmers because market supply and price of fresh produce are very erratic. Since Fresh produce has very short shelf life, if farmers process their produce, their income can be improved while supplying diverse products to the market. MAMRERC was conducted a research on preparation of different products such as tomato paste, ketchup, Jelly and Jam. Physico-chemical properties and microbial properties (bacteria, yeast and mould) were studied for the products prepared. Microbial examination revealed that the product is safe to consume in the stay of 6 months at farmers level. The main objective of this project was to demonstrate wholesome and low cost processed tomato paste as an alternative for consumers by elongating the shelf life of tomatoes for several months and to benefit farmers, Entrepreneurs and small scale processors for generating their income. The activity was implemented in two potential tomato production woreda's. A total of 20 female farmers were included in the project. Economic and perception data was collected and analyzed descriptively. In Terms of trial ability of the technology is well evaluated and it is found that the technology is much satisfactory. In terms of Relative advantage, the descriptive statistics and economic analysis revealed the new technique of preparation of tomato paste had an overall economic advantage. Moreover, the perception of women participants which confirms the relative advantages of the new technique as it is very effective and efficiency in minimizing the post-harvest losses of tomato. It was perceived that the technology is much more advantageous and acceptable. Hence, there is a need to scale out the reality for potential farmers, Entrepreneurs, cooperatives and other relevant actors by strengthening their awareness on the technology to use for them and give service around their area.

Key words: Tomato paste, Demonstration

INTRODUCTION

Tomato (Lycopersiconesculentum) is a popular & highly consumed vegetable worldwide. In Ethiopia as in many other countries, it is commonly used for table consumption as fresh or cooked dishes & for processing in to several products such as paste, puree, catsup, sauce or juice. Aside from its economic value, tomatoes & tomato products are vital to human nutrition, being rich sources of foliate, vitamin C, potassium, & more importantly, carotenoids (pro vitamin A &anti-oxidant activity), the most abundant of which is lycopene followed by beta-carotene, gamma-carotene & phytogenic. Other nutritional substances in tomatoes include vitamin E, trace elements, flavonoids, phytosterols, & several water soluble vitamins (Beecher, 1998).

There are different processing methods for tomato. In this case, simple and low-cost techniques of tomato paste processing will be focused to fit with the overall requirements and capacity of poor farmers, processors and entrepreneurs. Tomato paste is a concentrated tomato containing a minimum 24% of soluble natural dry matter or a soluble solids content of 24°Brix using a refract meter. But, in the rural areas where refract meter is not available,

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the desired soluble solids content can be determined by experience through the viscosity of the product. For example, if the end-point if 24°B, the tomato paste is sticky on the teaspoon and flowed slowly on the paper.

MAMRERC was conducted a research on preparation of different products such as tomato paste, ketchup, Jelly and Jam. Physico-chemical properties (Total Soluble Solids (TSS) Acidity, Ascorbic acid Content (AAC) and microbial properties (bacteria, yeast and mould) were studied for the products prepared. Microbial examination revealed that the product is safe to consume in the stay of 6 months. Hence, further demonstration and promotion of this Minimal processed tomato **paste** technique quite pertinent (MAMRERC, 2016).

During production peak, oversupply of fresh tomatoes in the market can be observed and price is much lower than during lean periods (summer season). Vegetable processing is a new vision for farmers because market supply and price of fresh produce are very erratic. Fresh produce has very short shelf life, if farmers process their produce, their income can be improved while supplying diverse products to the market. Additionally, vegetable processing can reduce imports and if products have competitive quality, this can open up export opportunities. The export market can stimulate agricultural activities. All of these can create more employment opportunities particularly in rural areas which is good to the economy. Hence, the overall Objective of the study is to demonstrate wholesome and low cost processed tomato paste as an alternative for consumers by elongating the shelf life of tomatoes for several months and to benefit farmers, entrepreneurs and small scale processors for generating their income.

Specific objective

- To demonstrate the value added on flavor, good quality sauce & low cost processed tomato paste
- To determine the shelf life of tomato paste by inactivating surface microorganisms and enzymes within the product under farmers condition
- To introduce tomato paste technique to farmers, small scale cooperatives

MATERIALS AND METHODS

The study area

The activity was undertaken in Raya alamata woreda, Tigray regional state of Ethiopia. A total of 20 female farmers, and local traders were included in the project in based on their willingness and capability of managing the technical back up.

Materials

- Red-ripe, unbruised and high quality tomatoes for the demonstration was used for making tomato paste which was bought from growers in the local area.
- Fresh ripened tomatoes, 120kg
- Teaspoon
- Jar (glass bottle), cape , polyethine tube
- Filler
- Wood and stove
- Pulper (sharp knife)
- Sieve (stainless) or cotton sack
- Salt, pectin
- Washing pail or basin
- Towel
- Spices

Therefore, Researchers, respective woreda staffs of MoA, and participants were jointly manage the activities. Data on perception of the farmers towards the technologies was collected using ranking, scoring and other parameters. Along this relevant marketing data that is pertinent to the technology was collected. The data was analyzed using descriptive statistics.

Steps followed during processing

Step1: Pre-processing. Tomatoes at optimum quality (red-ripe stage but firm) and free of defects (insect or disease damage, physical injuries) was selected.

Step2: Blanching and peeling. In order to soften the skin for easy peeling and inactivate the enzymes, particularly catalase and peroxidase blanching was done for 5-10 minutes at controlled temperature in boiling water and cooled in cold water for 5-10 minutes.

Step3: Seed separation and crushing. The fruits were sliced into half and the seeds were scooped out using a teaspoon. Seeds could impart bitter taste to the product.

Step4: Concentrating or Cooking. Cooking was done for several hours until enough water was removed to produce a thick red concentrate.

Step5: Pasteurization or sterilization. To destroy the enzymes of vegetative bacteria and fungi sample container was dipped in boiled water for 20-minute.

Storage period of the processed paste was evaluated in 2 months, 4 months, 6 months and 8 months with visual appearance, external appearance and microbial load

RESULTS AND DISCUSSION

Characteristics of tomato paste preparation technique

There are different processing methods for tomato. In this case a simple and low-cost technique of tomato paste processing was focused to fit with the overall requirements and capacity of poor farmers, processors and entrepreneurs. Tomato paste is a concentrated tomato containing a minimum 24% of soluble natural dry matter or a soluble solids content of 24°Brix using a refract meter. But, in the rural areas where refract meter is not available, the desired soluble solids content can be determined by experience through the viscosity of the product. For example, if the end-point if 24°B, the tomato paste is sticky on the teaspoon and flowed slowly on the paper (MAMRECRC, 2016).

Tomato paste is helping farmers to ensure that the products can be stored for personal consumption or later sale. Tomato paste is easy to handle and come in various amount. Any farmer who has tomato paste on his home can use or preserved tomato all year round and is free to decide when to bring his/her product/ harvest to use or market.

The high acceptance of tomato paste is due to the following reasons

- Easy to prepare and handle
- Improve hygiene

- Preserve quality tomato
- Very inexpensive
- Make work easier for women
- Tomato paste are kept safe
- Adaptable to the needs of small farmers
- Offers marketing advantages during time of scarcity and prevent post-harvest losses

Trial ability of the technology how easily a farmer can learn about an innovation's performance and management. The value of trials is that they reduce uncertainty about the innovation and develops skills in applying the innovation. (Pannell *et al*, 2006).

Based on these idea 9 characteristics of innovations that affect an innovations' trial ability is used to evaluate the method of preparation of tomato paste and the tomato paste itself. And the technology is evaluated by researcher, experts and farmers accordingly. The following are characteristics of a highly trial able innovation:

Highly divisible or trial able: Tomato paste might be made in different amount. Based on the interest of the household the technology could be prepared in different amount. Thus the technology is easily trial able in small scale at any time and place.

Strongly observable results: Tomato paste has a short response lag time between using the innovation and seeing results. It takes no time to observe the result just in three months farmers can evaluate the technology after they carefully prepared the innovation.

Complexity: tomato paste is very simple technology. It needs some training to understand how to prepare and use tomato paste. Moreover it is easy to hand and requires only small space. Thus this technology has low or no complexity to understand and to use it by end users.

Cost: To prepare tomato paste only few cost are needed. This cost may include cost of tomato, cost of material for preparation such as fuel and labour costs. In terms of its relative advantage this cost is relatively low with the consideration of highly post-harvest loss due to lack of proper preservation. Thus, farmers may need to incur this cost to benefit more.

Low risk of failure of the trial: If properly prepared as per the manual**,** this technology has less risk of failure. However, if there is no proper preparation and the containers is not clean and free enough from any contamination, the technology has a great risk of failure, Moreover the contain is not closed properly and air is inter to the inner container there may be total loss.

Innovation similar to normal practice: All most all users and producers of tomato have not used any method of preservation mechanism. As a result there is a great tomato post-harvest loss. Tomato paste was adopted and developed by researchers is simple to prepare and is very effective to prevent this great post-harvest loss. With simple training users can handle the tomato paste preparing method. Users also need additional skill or special training to identify the different cause and signs of spoilage for better preservation.

Strong linkage between the landholder's practices and the problem being addressed: Lack of tomato preservation is one of the main constraints in tomato utilization. Some study shows that about 92 % post-harvest loss in tomato and it remains unmarketable or sold at low price. The new technology tomato paste helps to address such problems by preserving for long time and Offers marketing advantages during time of surplus production. Therefore this technology is effective to solve really problems of tomato post-harvest losses.

Gender Aspect of the technology: day-to-day management of food preparation is undertaken by women, often with assistance from their female children. There for this technology is intended to solve women problem in their daily activity. Once they prepare the tomato paste, they can use for long time. Thus they do not need day to day work on the preparation to cook (Table 1).

Indicates sensory attributes of tomato paste: Sensory evaluation

Sensory property is reported as the indicative and quality parameters for the tomato paste product of the samples were measured to quantify the extent of the characteristics difference between tomato paste and fresh one.

Five trend panelists were used to made pretest. A five point hedonic scale was used to determine the organoleptic attributes and acceptability of the complementary foods. The number "5" represented 'like very much, '1' represented 'dislike very much'. The observations and suggestions made by the trend panelists were used to improve on the preparation of the tomato paste processing.

A total of 20 mothers were selected for the sensory evaluation. They were selected randomly from the mothers who have tomato paste. These mothers voluntarily accepted to participate after thorough detailed discussion session and interview and the result shows (Table 2).

Table 1: Evaluation of the characteristics tomato paste

Trail ability Characteristics of Tomato paste	Frequency (N=20)	yes (%)	no (%)	remark
1. Highly divisible/easily triable	19	95	5	
2. Strongly observable results	20	100	0	
3. A short response lag time	18	90	10	
4. Low complexity	16	80	20	
5. Low cost	20	100	0	relatively
6. Low risk of failure of the trial	1	5	95	
7. Well implemented trial	16	80	20	
8. Innovation similar to normal practice	4	20	80	not but simple
9. Strong linkage between the landholder's practices (and thus innovation) and the problem being addressed	18	90	10	
10. Gender neutral	20	100	0	

Source: MAMRERC, 2016

Table 2: Indicates sensory attributes of tomato paste: Sensory evaluation

Frequency (20)	like	% Like	% Dislike
Colour	4.55	91	9
Smell	4.3	86	14
Taste	4.2	84	16
consistency	3.2	64	36
Over all acceptance	4.2	84	16

Source: MAMRRC, 2016.

Perception of farmers on attributes of prepared tomato paste

The Innovation has to perform satisfactorily in the job it was intended for. The advantage that it gives the farmers has to be in line with the identified problems. An innovation's perceived relative advantage 'is the decisive factor determining the ultimate level of adoption of most innovations in the long run' (Pannell *et al.* 2006).

A. The cost or profitability of the practice the innovation would replace

Tomato paste preparation, the cost may have been in terms of post-harvest loss minimization and utilization when the price tomato is high. The cost benefit analysis reveals that the new technique of preparation of tomato paste had overall economic advantage and the perception of participant farmers is in line with the economic verification trail result under taken by MAMRERC.

Partial Budget Analysis of introduction tomato paste preparation

Tomato paste could be made in different amount. In this analysis 30 kg of tomato was taken for one month to feed five persons per day. The main advantage of the new technique is decrease post-harvest losses of tomato by preparing tomato post by preserving the given amount of tomato in low price season and to use when the price of tomato is peak in the year.

Partial budget analysis result reveals that the new technique of preparation of tomato paste has very small cost and better return as compared to the normal practices. And new technique is 5.93 time more efficient (Table 3).

Time saving: The work is total performed by female member of the household. This day to day activity was no considered as a job even though it consumes much of their time. This new technique helps women to save much of their time and they could spend their time in other activities. In terms of time saving the result shows that the new technique save 80 % of the time they spent in their day to day activities.

Safety and comfort of tomato paste: a great care is needed in preparation of the tomato paste. It needs proper hygiene and personal sanitation unless a great problem may be created in the health of the users. If, however, the new preparation of tomato paste is properly managed no more problem is encountered besides the technology is used by cooking thus the paste is safe and healthy to use after several months.

Suitability in small scale: all of the participant farmers perceive that this tomato paste is very suitable to prepare in different amount and use at any time in their home based on their socio economic condition. If someone has the ability to afford large amount, he/she can prepare and use the year round. Whereas those who has and need small amount they could prepare and use the small amount.

Perception of farmers on Cost of preparation of tomato paste: with their current price fluctuation in tomato, this tomato paste is a good technology to stable the market. Especially at is time the price of fresh tomato is unaffordable by consumers and in the time of production, its price will be very low which cause discomfort and great loss in the producer side (Table 4).

The innovation's effect on the family lifestyle

Preparation of Tomato paste is introduced to decrease post-harvest loss and to stabilize market. The implement has no any negative effect in the family life style rather it supportive and can be managed by female member of the family.

Table 3: Cost benefit analysis of preparation of tomato paste

	parameters	Traditional technique t=x; P=5	New technique t=x; P=5	Traditional technique t= y; P=30	New technique t=x; P=30	value
1	Price of tomato	150	150	900	150	Lobour=120
2	Fuel cost	210	35	10	35	
3	Time taken	900	120	900	120	
4	Cost time (birr/min)	225	30	225	30	
	Total cost	585	215	1335	215	

Source: MAMRERC, 2016; Total cost from traditional technique= 1335 to prepare given amount of tomato; Total cost from traditional technique= 215 to prepare given amount of tomato; Efficiency = 1335/225*100=593.33%; that is the new technique is 5.933 times more cost efficient than the traditional one.

Table 4: Perception in the Attributes of preparation of tomato paste: Relative Advantage

Parameters Relative Advantage	Frequency N=20	% (yes)
1. The expected profitability of the innovation	20	100
3. low cost or profitability of the practice the innovation would replace	20	100
4. low Adjustment costs involved in adopting the innovation	15	75
5. No effect on the riskiness of production/outcome	10	50
6. No Negative effect on other components of the farming system	20	100
7. No Negative effect on the family lifestyle	20	100
8. compatible with a farmers' existing technologies, practices and resources	20	100
9. The innovation's compatibility with existing beliefs and values	20	100
11. The innovation's low complexity	14	70

Source: MAMRERC, 2016.

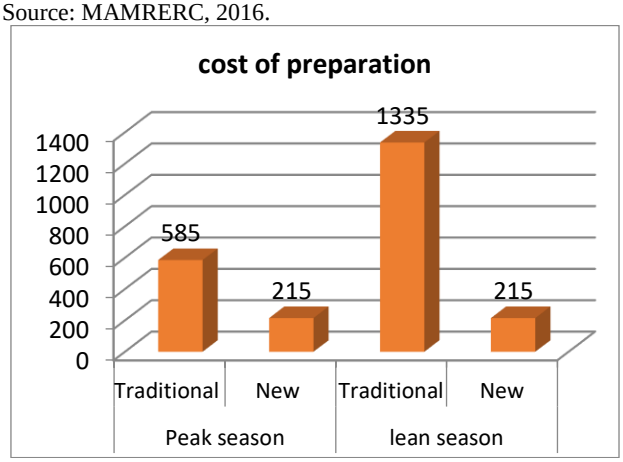

Fig 1: Cost of preparation of tomato paste

The innovation's compatibility with a landholder's existing technologies, practices and resources

The preparation of tomato paste has Minimum deviation from the existing practices. It needs simple training and some addition skill to manage the new technology. All the participant farmers perceive that the new technique of preparation of tomato paste has no compatibility problem with existing beliefs and values. Moreover the technology is aimed to prevent post-harvest losses which is more supportive to the Government policies especially in the prevention of post-harvest loss and price /or market stability.

Conclusions and recommendations

Since value addition and product diversification is of paramount importance in the present market scenario. More diversified products from tomato like tomato paste have much importance as a method of preservation and post-harvest loss prevention. The developed product was retained original fruit flavor and safe for consumption. Development of such nutritional products using pilot scale facilities were not only reduces the postharvest losses but also impart value to less appreciated vegetables. Moreover, it makes for greater food security and Offers marketing advantages during time of scarcity since it decrease the post-harvest loss of tomato through improved managements including preservation will result in increasing opportunities of equitable distribution of food and income for the households of rural areas. Producer can sale their use the product tomato paste at any time at peak price.

Therefore, preparing of such products will provide ample avenues for employment generation in the rural masses by way of setting small scale processing unit. To reduce uncertainty about the innovation and develops skills in applying the innovation. Trial ability of the Preparation of tomato paste is evaluated by stokeholds such as researchers, experts, health works and end users: farmers. The characteristics of preparation of tomato paste were evaluated according how easily a farmer can learn about an innovation's performance and management.

In Terms of trial ability, different factors such as Highly divisible/easily trial able, Strongly observable results, A short response lag time, the effectiveness in the problem being addressed and other factors of the Preparation of tomato paste was well evaluated and it is found that the technology is much satisfactory. Therefore it was intended to demonstrate and popularize in the farmer's field level for further evaluation. The demonstration and popularization activities were carried out in Tigray.

In terms of Relative advantage, the technology is deeply evaluated by farmers. It was perceived that the technology, Preparation of tomato paste, is much more advantageous innovation and the study shows it has overall relative advantage over the Traditional.

According to the results of this evaluation, almost all stokeholds are well aware its trail ability and its relative advantage over the existing practices. In general the method of preparation and technology, tomato paste, was Economic, social, Environmental, cultural and personal, is acceptable technology.

Since this practice is very acceptable by women farmers and users at peak production period we recommend scaling up to other areas. But great care and continues training and supervision needs on how they prepare and store. The adoption of the preparation of this product to the rural community.

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