FRESH PRODUCE TOMATO VALUE CHAIN IN BANGLADESH

A Thesis
by

MD. JASIM UDDIN
Examination Roll No. 08 FPM - JD 05M
Registration No. 30501
Session: 2003-2004
Semester: July-December, 2010

MASTER OF SCIENCE (MS)
IN
FARM POWER AND MACHINERY

DEPARTMENT OF FARM POWER AND MACHINERY
BANGLADESH AGRICULTURAL UNIVERSITY
MYMENSING

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Submitted to the Department of Farm Power and Machinery
Bangladesh Agricultural University Mymensingh
in a partial fulfilment of the requirements
for the degree of

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DECEMBER 2010
DEDICATED
TO MY
BELOVED PARENTS
The purpose of the study was to identify the fresh produce tomato value chain and post-harvest losses in different stages of value chain in Bangladesh. The study also identified the value addition in ketchup production from fresh tomatoes. The major actors of fresh produce value chain of tomatoes are identified as tomatoes producers, local market middlemen/forias, city wholesalers/Arotdars, city/district market retailers and consumers. Almost 90% of the total fresh tomatoes are supplied to city/district wholesale markets and the rest 10% of the produce is consumed locally. The major value additions in the fresh produce tomatoes value chain are transport to local market 20%, middlemen (foria) 30%, city/district market wholesaler/Arotdar 30% and retailer 20%. The losses in the post-harvest marketing chain of fresh produce tomatoes due to grading and transportation to local market; long transport, packaging, storage at middlemen (Foria); handling and storage at city/district wholesaler/Arotdar; and city/district market retailers were found 13%, 4.5%, 10.8% and 8.1%, respectively. The total average loss was found as much as 36.4%. The ketchup industry collects fresh tomatoes from city/district wholesale market and add value in loading, unloading, carrying, grading 0.70%, washing & boiling 0.70%, pulping 1.75 %, preserving 2.10%, pre-process or mixing process 28.07 %, spices 7.01 %, heat treatment 1.75 %, bottles with label 3.5%, packaging 1.75% and profit 52.6%. The total value addition for 1kg of fresh tomato is estimated asTk.285, where price of 1kg tomato and its product (six bottles of tomato ketchup including ingredients) are Tk.15 and Tk. 300, respectively. For easy preservation and flow of benefits to producers, fresh tomatoes can be processed into pulp that can reduce the losses of fresh tomatoes in peak harvest.
ACKNOWLEDGEMENTS

All praises are to Almighty Allah, who enables the author to complete the MS research.

The author deem it a proud privilege to express his deepest respect & heartfelt thanks and sincere appreciation to his respected supervisor Dr. Md. Monjurul Alam, Professor, Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh for his continuous supervision, worthy guidance & valuable suggestions.

The author politely expresses his deep sense of gratitude to his respected teacher Chayan Kumer Saha, Associate Professor, Department of Farm Power and Machinery, BAU, Mymensingh for his valuable suggestions, constructive criticism and constant inspiration from the beginning to the end of the study. The author also expresses his gratitude to all teachers of this department for the support and continuous encouragement.

The author thanks all of his friends, especially Anisur Rahman (Sojol) for his continuous help. Sincere acknowledgement to Fahmida Aktar (Liza), for her inspiration to the author to complete this study successfully.

Finally thanks to all respondents, for their co-operation during data collection. Great thanks to Jahangir Hossain, Manager Admin, Prince group of company Ltd., Dhaka for his help by supplying important information and guidance during data collection session.

The Author
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CHAPTER I
INTRODUCTION

The tomato (*Lycopersicon esculentum*) is one of the most important vegetable in Bangladesh. It is extremely perishable and cannot be preserved in fresh stage. Huge post-harvest losses of the harvested tomatoes occur due to inadequate storage facilities, which brings substantial loss to the growers and hence to the national economy. Preservation of tomatoes as semi-processing system not only takes care of the marketable surplus but also ensures the supply of raw materials for finished products like sauce, ketchup, drink etc. A simple technology of concentrating tomato pulp kept in locally available containers might be a solution to the problem of huge tomato loss during harvesting period. The composition of tomato per 100g of edible part is shown in Table 1.1.

**Table 1.1 Composition of tomato (per 100gm of edible part)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>93.1 g</td>
</tr>
<tr>
<td>Protein</td>
<td>1.9 g</td>
</tr>
<tr>
<td>Fat</td>
<td>0.1 g</td>
</tr>
<tr>
<td>Minerals</td>
<td>0.6 g</td>
</tr>
<tr>
<td>Fibre</td>
<td>0.7 g</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>3.6 g</td>
</tr>
<tr>
<td>Sodium</td>
<td>45.8 g</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>320 I U</td>
</tr>
<tr>
<td>Thiamine</td>
<td>0.07 mg</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>0.01 mg</td>
</tr>
<tr>
<td>Nicotinic acid</td>
<td>0.4 mg</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>31 mg</td>
</tr>
<tr>
<td>Calcium</td>
<td>20 mg</td>
</tr>
<tr>
<td>Magnesium</td>
<td>15 mg</td>
</tr>
<tr>
<td>Potassium</td>
<td>114 mg</td>
</tr>
<tr>
<td>Copper</td>
<td>0.19 mg</td>
</tr>
<tr>
<td>Sulphur</td>
<td>24 mg</td>
</tr>
<tr>
<td>Chlorine</td>
<td>38 mg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>36 mg</td>
</tr>
<tr>
<td>Iron</td>
<td>1.8 mg</td>
</tr>
</tbody>
</table>

Source: Aykroyd (1963)

Tomato is a popular winter vegetable in Bangladesh. It’s sowing and harvesting periods are mostly confined in mid August to mid November and December to mid January, respectively. Tomato requires day temperature of 21° – 28° C and cool night temperature of 15°-20° C for proper fruit setting (Grubben, 1977). The optimum relative humidity of tomato production in Bangladesh is 70% (www.actahort.org).
Statistics show that area coverage for tomato cultivation in Bangladesh was about 25,000 hectares in 2007 with a production of 0.11 million ton and the production had been increasing steadily. The production position of tomato is 6\textsuperscript{th} from all vegetables in Bangladesh. The average yield of tomato was 7.24 ton/ha (BBS, 2007). This yield is very low compared to some advanced countries.

The post-harvest loss of food reduces the total amount of food available to the consumer of our country. Enough attention has been paid at the pre-harvest stage for boosting the levels of production by techniques like crop rotation, soil conservation, pest control, fertilizer, irrigation etc. but post-harvest issues has been handled inadequately. Considerable amount of vegetables, especially tomato is lost in the post-harvest chain during its movement from farmers’ field to consumers table due to improper handling, storage and lack of awareness.

In 2006-07 the total production of tomato in Bangladesh was 1,19,935 ton (BBS, 2007) and the loss was estimated approximately 39,146 ton (32.64%). Similar post-harvest loss of tomato (32.64%) was observed in Bilaspur District, Madhya Pradesh, India (Gauraha 1999). In the same period, the price of tomatoes in season (winter) was Tk. 20/kg and the net loss incurred was Tk. 782 million. If it is possible to eliminate about 50 percent of this total loss by proper post-harvest management (handling, packaging, storage), we shall be able not only fulfill our national demand but also export a large amount tomatoes each year.

To reduce the losses of tomato in harvesting period (peak period) by applying a simple technology as concentrating tomato pulp kept in locally available containers and for finished products like ketchup, sauce, etc. Therefore, it is important to investigate the fresh tomato value chain up to ketchup industry and the value added for the final product.

The main objectives of the present study were:

1. to identify fresh produce tomato value chain for ketchup industry,
2. to identify the value chain of ketchup production from fresh tomatoes, and
3. to determine the value addition in fresh tomatoes and tomato ketchup.
CHAPTER II
REVIEW OF LITERATURE

Ajay Verma (2003) reported that the overall losses varied up to 20% in vegetables like tomatoes, cabbage, cauliflower and chili in India. The estimated losses of tomatoes were 10, 14, and 20% at wholesale, retailer and farm level, respectively. Maximum loss was observed at retailer level. The high moisture content of tomato incurred maximum loss during storage.

Brushing is the most prevalent source of physical damage and wastage at the retail link in the post-harvest handling chain (Opara, 2003). Estimates of average total waste range from 3 to 19% across supermarket, while the amount of loss directly associated with handling damage (including brushing) was approximately 2%. All fresh produce manager consistently identified tomato as the most important contributors to total wastage. In a typical fresh food section of retail supermarket store with annual turnover of 2.97 million US$ losses associated with handling damage alone exceeded 59340 US$ per annum.

Ferreira (2006) reported that the tomato post-harvest losses are very high in Brazil, the effect of handling and the transport of tomato from the harvesting, weighing, and transportation to the packinghouse were identified as critical points. Handling were the cause of an increase by 6.6% in external damage and 1.93% of weight loss after storage. The main reason of post-harvest losses was due to mechanical injury caused during transportation mainly due to compressive force among fruits and against the plastic boxes.

Gauraha (1999) reported the overall post-harvest loss towards the consumption end of the distribution system was around 17.26% of the harvested quantity. Maximum post-harvest loss was observed in tomato is 32.64%. Factors responsible for post-harvest losses are identified and some remedial measures to reduce losses are suggested.

Kharche (1998) reported that the response of surface methodology (RSM) was used to evaluate the effect the box height (250-450 mm) and distance traveled (210-450
km) on the decrease in firmness and bruised surface area of tomatoes in corrugated paper boxes. Optimization of the process was performed to produce the minimum damage of tomatoes. Computer generated response surface and contour plot interpretation revealed that minimum box height (250mm) and moderate travel length (350 km) should be optimum with a minimum decrease in firmness of 25.90% and minimum bruised surface area of 6.18%.

Pal (2002) stated that total losses of tomato during different post-harvest operations were found in the range of 30.3-39.6%. The maximum quantity of losses occurred during transportation from rural markets to urban markets. The loss of water from tomato was less due to its impermeable outer skin. The pH value remained almost constant in the case of tomato.

Kaaya (2004) reported that tomato fruits harvested at mature green stage were subjected to impact bruising at three treatments. The selected tomatoes were also of similar shape and size to avoid size and shape related variability. Treatment one was the control in which fruits were not dropped at all (no damage). For treatment two the tomato were respectively dropped five times from a height of 30 cm onto a polyvinyl chloride chopping board. For the treatment three, the drop condition was similar to treatment those of treatment two, the dropping were repeated ten times. The drops were meant to simulate handling, road and vehicle conditions that the tomatoes are subjected to from the areas of production to market outlets. Respiration compositional and physical changes were measured before damage (dayo) and there after everyday for 7 days. Result indicates that impact bruising had significant (P> 0.05) effects on the studied parameters. Treatment three in which fruits have been dropped 10 times, had significantly lower levels of respiration then the other two treatments, while control had the highest. In the case of tritrable acidity the fruits dropped 10 times significantly (P>0.05) higher level than the fruits dropped 5 times and the control pH level followed inverse trend to that of tritrable, acidity as the two parameters have an inverse relationship.

Luengo (2001) reported that the most common box for harvested vegetables in Brazil is the wooden boxes. These boxes cause mechanical damage and reduce vegetables self life and quality due to its rough surface allowing pathogen colonization, due to the excessive number of fruit layers and due to the lateral cut
opening. Embrapa Hortícolas (1997) develop an adequate box to protect tomato fruits. The definitive box named “Embrapa box” was compared with the K box and the most common plastic boxes from the market. The weight self-life, colour, mechanical damage, firmness, relative water content and the deterioration were evaluated. The damage was significantly different and lower in the Embrapa box, reducing post-harvest losses of tomato fruits.

Park (2005) reported that quality changes in fruits tomato harvested at breaker and pink stages were investigated during simulated shipping, storage and self life to evaluate the effects of harvest maturity and PE (polythene) film packaging on fruit quality. The soluble sugar content, measured by glucose and fructose analysis was higher in pink fruits than in breaker fruits at harvesting and storage. PE film packaging appeared to be effective in the maintenance of soluble sugars, especially when ethylene absorbent was added into the package. Weight loss was greater in breaker fruits than in pink fruits when stored without film packaging. PE film packaging significantly prevented weight loss in breaker and pink fruits. Flesh softening progressed remarkably within a few days after harvesting. Film packaging with ethylene absorbent tended to delay softening in breaker fruits but not in pink fruits. The value of surface hunter L increased during the shipping period and the levels of increase were higher in pink fruits and in the treatment of film packaging with ethylene absorbent. In contrast, the value of hunter ‘a’ increased slowly in fruits packaged in PE film as pigmentation was delayed. The ethylene concentrations inside film packages of breaker and pink fruits were 0.6 and 1.1 ppm, which increased to 9.1 and 6.9 ppm, respectively.
CHAPTER III
METHODOLOGY

3.1 Introduction

The present study was undertaken to identify the value chain of tomatoes, from farmer up to tomato ketchup industry and the post-harvest losses of tomatoes through the value chain. To describe the procedure of making tomato ketchup from fresh ripen tomatoes in industry of Bangladesh. This study was based on field survey where primary data were collected systematically by means of an interview schedule from individual actors and by visiting the tomato ketchup industry.

3.2 Site Selection

The study area was selected based on large-scale production of tomato and nearer to the research station. The selected study areas were Poradia, Belabo, Narshingdi and Karoan Bazar of Dhaka city. The maximum production of tomato was 4,685 metric ton from cultivated area of 1025 hectares in Narshingdi during 2006-2007 (BBS, 2007).

3.3 Preparation of Interview Schedule

The draft interview schedule was prepared according to the objectives of the study with active consultation with the key informants, expert from the relevant fields and secondary information. The draft schedule was pre-tested and necessary corrections, modifications and alterations were made accordingly and printed for field data collection (given in Appendices A & B).

3.4 Data Collection

Data were collected through personal interview and visiting tomato process (tomato ketchup) industry. During interview of the farmers, each question was explained to them clearly and tired to found out fact as much as possible. Before taking interview, the whole purpose of the study was clearly explained to the respondents. Initially
many of the respondents were reluctant to answer the questions. When they were assured that the study was purely an academic one and was not likely to have an adverse effect on them, they tried to make good cooperation. The farmers do not keep record about their post-harvest activities. The problem was confronted by memory recalling technique. Information were also collected from farmers, consumers and industry level. There are several intermediate levels in between these two levels. The intermediate levels are middlemen/Forias, wholesalers, retailers etc.

To identify the problems and prospects of post harvest operation of tomatoes and its bearing on the farmers were also taken care off. Data related to tomato ketchup production were collected from Prince group of company Ltd. during 20-28 January, 2010.

3.5 Identification of Value Chain

In this study, the actors of the value chain of tomatoes were identified and the incidence of post-harvest losses were also determined throughout the chain using a combination of pre-designed structured questionnaire and written comments provided by produce managers and test of sample of damaged produce.

3.6 Loss Assessment

The total weight of tomatoes harvested from a field of definite size was recorded. After harvesting, tomatoes were sorted and rejected amount of tomatoes due to crack, cuts, bruising, over-ripening was weighted and these losses were termed as harvesting losses. The tomatoes that sustained damage during transportation, handling, packaging and storage were sorted out and weighted to estimate the losses at different levels. In each stages of unloading, the damaged tomatoes were weighted. From the weight of good tomatoes obtained after sorting the losses in percent due to handling, transportation and storage were estimated as per the equation given below:

\[
\text{Loss of tomato, (\%)} = \frac{W_{dt}}{(W_{dt} + W_{gt})} \times 100
\]
Where, $W_{dt} =$ Weight of discarded and damaged tomatoes, $W_{gt} =$ Weight of good quality tomatoes obtained after sorting a lot during any stage of handling. The experiment was replicated five times in different fields and post-harvest stages in value chain.

3.7 Identification of tomato ketchup making procedure

In this study for identifying tomato ketchup making procedure, the Prince Group Company Ltd. in Dhaka was selected on the basis of large scale supply of tomato ketchup in the market and their market demand. The researcher visited the industry, interviewed different types of workers in different processing stages, and finally talked with the manager administration about the procedure for producing tomato ketchup. Photographs of different stages of processing were taken for the study purposes. Necessary co-operation were ensured by both the workers and the administration of the Prince Group.

3.7.1 What is Tomato Ketchup?

Tomato ketchup is a secondary processed products of fresh tomato, have come to be consumed in vast amount today in our home as well as in restaurant and other places as an indispensable food in our daily living. Ketchup, a tangy, seasoned tomato sauce, is one of favorite condiments. Although ketchup, also spelled catsup, is used primarily as a relish for hamburgers, hot dogs, and french fries, it is also a common ingredient for sauces, meatloaf, beans, and stews.

3.7.2 Ingredients of Tomato Ketchup

- fresh tomatoes
- sweeteners
- water
- vinegar (acitic acid, citric acid and sodium benzoate)
- salt
The types of sweetener used are usually granulated cane sugar or beet sugar. Other sweeteners include dextrose or liquid sugar in the form of corn or glucose syrup. The white vinegar, commonly 100-grain distilled, helps to preserve the ketchup. The spices commonly used to enhance the flavor of the tomatoes are allspice, cassia, cinnamon, cayenne, cloves, pepper, ginger, mustard, and paprika. Some manufacturers believe that whole spices produce a superior, more mild flavor than ground spices or spice oils. More modern processes use premixed or encapsulated spices, which are easier to use but more expensive. Whatever the form, spices must be of a high quality.

The various brands of ketchup have slightly different formulas, which vary primarily in the amounts of spices or flavorings. Thicker consistencies require a greater ratio of sugar and spices relative to the tomato juice. Occasionally formulas must be slightly adjusted according to variations in the acid and sugar content of tomatoes, which occurs with changes in growing conditions and types of tomatoes.
CHAPTER IV

RESULTS AND DISCUSSION

4.1 Fresh Produce Value Chain of Tomatoes

The value chain of tomatoes is identified on the basis of field investigation right from the producers to consumers. In forward linkage, the channels are investigated up to consumers. On the other hand, in backward linkage the investigation goes down to the tomato producers of Poradia, Belabo and Narshingdi.

The supply of tomatoes in city market, Karoan Bazer, Dhaka is greatly depending on production size, transport facilities and demand of the consumers. Farmers of Poradia, Belabo and Narshingdi are selling their produce tomatoes in local/village market, middlemen (foria) and directly to the local consumers. The forias supply tomatoes to the district and city wholesalers/Arotolars. The wholesalers stock (few trucks) tomatoes to the godown of Arotolars or in own godown for selling to city/district market retailers. The retailers are selling these tomatoes to consumers. A part of fresh tomato was collected by tomato ketchup industry from Arotdar of city market. A common fresh produce value chain of tomatoes is shown in Diagram 4.1.

4.2 Post-harvest Losses of Tomatoes

A huge amount of tomatoes are being lost in different post-harvest operations such as handling, storage and transport. When farmers are carrying tomato to sell in village market by boat, van, and trolley etc. excess pressure by bulk weight and vibration of vehicle incurred losses. Similar losses were found in long transport between local market to city/district markets by track for vibration, bulk pressure and improper packaging of tomatoes. A typical loss chain was tried to identify for 100 kg of tomatoes from producers to consumers level/ketchup industry. In case of 100 kg tomatoes, 13% was lost due to grading and transportation to local market, 4.5% was lost in storage at middlemen (Foria), 10.8% was lost due to long transport, packaging, handling and storage at city/district wholesaler/Arotdar, and 8.1% was lost at city/district market retailers. Another part of marketing chain of fresh tomatoes
shows from city/district wholesaler/Arotdar to tomato ketchup industry and the loss was 1.35%. Tomato ketchup are reached to the consumers through company distributors and retailers. The total average loss was found as much as 36.4% through the major chain. The losses of tomatoes at different stages with percent are shown in Diagram 4.2.

Diagram 4.1 Fresh produce marketing chain of tomatoes in Bangladesh

- **Producer or Farmer** Tk 7/kg
- **Local/Village market** Tk 9/kg
- **Foria/Middlemen** Tk 12/kg
- **City/District market-Arotdar/Wholesaler** Tk 15/kg
- **Consumer**
- **Distributor**
- **Groser/Retailer** Ketchup from 1 kg tomato Tk. 300/6 bottles

Diagram 4.1 Fresh produce marketing chain of tomatoes in Bangladesh
Diagram 4.2 Loss chains of tomatoes from production level to consumer

4.3 Transportation of Tomatoes through the Marketing Chain

The handling techniques of tomatoes before marketing are generally less adapted to the fragile and perishable nature of the product. In Bangladesh, men transport tomatoes on their heads, behind bicycles or motorbikes/van/boat or in rickshaws to their houses or to the local markets for selling.

Tomatoes are bought from the villages are piled up in markets located in the production zones, then loaded in bulk/khaci/plastic case in trucks for traveling to big
distribution and consumption city/district markets situated at hundreds of kilometers away. They were unloaded without caution at the destination. These different modes of packaging and transportation exposed the tomatoes to damage and low market quality.

Figure 4.1 Preparation for long transportation by truck through bulk loading

Figure 4.2 Local transportation of tomatoes by van

4.3.1 Trucks used for long transport of fresh produce tomatoes
Most fresh produce is now moved in road vehicles and lesser amount in waterways. The vehicles in most common use are open pick-ups or bigger trucks, either open or enclosed. The use of road vehicles is likely to increase, so users should give attention to the following:

- Closed vehicles without refrigeration should not be used to carry fresh produce except on very short journeys, such as local deliveries from farmers or wholesalers to nearby retailers;
- Open-sides or half-boarded trucks can be fitted with roof on a frame. The open sides can be fitted with canvas curtains which can be rolled up or moved aside in sections to allow loading or unloading at any point around the vehicle. Such curtains can protect the produce from the elements but still allow for ventilation. Where pilfering is a problem, the sides and rear of truck must be enclosed in wire mesh;
- A second, white-painted roof can be fixed as a radiation shield 8 or 10 cm above the main roof, this will reflect the radiation from the sun and help to keep produce cool.
- For the ventilation of long distance vehicles, more elaborate air intakes can be fitted in conjunction with louvers, to ensure a positive air flow through the load.

### 4.3.2 Other modes of transport

Fresh produce is transported by many other means, from head-loads to trucks/waterways, in all cases, the same condition should be observed. Produce must be:

- kept as cool as possible
- kept dry
- moved to market as quickly as possible.
**Rail transport:** In Bangladesh a small amount of tomatoes is carried by rail. The advantages are:

- transport damage to produce while moving is slight as compared with that from haulage over rough roads.
- cost is lower than transport by road.

Rail transport, however, requires extra handling since road transport is needed to and from the rail journey, transport by road alone usually is a door-to-door service.

4.4 Processing of Ketchup from Tomatoes

Ketchup manufacturers must seek out the best quality tomatoes for their product. Tomato varieties are developed which are superior in color, flavor, texture, and yield. Consistency is an important factor, as slight variations in tomato characteristics could alter the flavor and color of the finished product. The steps of process and process diagram of tomato ketchup is shown in Diagram 4.3.

- Preparation of tomato
- Pulping
- Preservation
- Adding ingredient and cooking
- Filling and cooling
- Labelling and packing

4.4.1 Preparing tomatoes

Tomatoes are harvested mechanically between June and July. The fruit is commonly conveyed by water from the trucks into a flume, or an inclined channel. The water method washes the tomatoes and protects them from bruising while they pass from the truck to the factory. The tomatoes are sorted, washed, and chopped. Next, precooking, or scaling, in stainless steel vats preserves the tomatoes and destroys bacteria.
4.4.2 Pulping/semi-processing of tomato pulf

The chopped and precooked tomatoes are pumped into pulping machines, or cyclones, which separate seeds, skins, and stems from the pulp. The pulp and juice are filtered through screens and processed further into ketchup, though some may be stored in a paste for use later in the year.

Preservation of tomatoes as semi-processing system not only takes care of the marketable surplus but also ensures the supply of raw materials for finished products like sauce, ketchup, drink etc. A simple technology of concentration tomato pulp kept in locally available containers might be a solution to the problem of huge tomato during harvesting period.

Tomato pulp after extraction should be strained in mosquito net/bamboo made sieves to remove the seeds and other coarse fractions. The pulp is concentrated in open cooker as per method outlined by Bhatia (1982). The pulp is concentrated to 10 degree B (Brix) from the initial TSS (Total soluble solid) of 4 degree B (Brix) and added citric acid 0.2% and sodium benzoate (1000ppm).

The pulp was filled hot into sterilized bottles followed by further processing of the filled bottles for 20 minutes in boiling water. The processed bottles were sealed, kept inverted for 5 minutes. When cool, the mouth of the filled bottles is dipped in molten wax and then the bottles should be stored in a dry, clean and cool place (Diagram 4.3). PRINCE group also preserves these pulps by mechanized process and follows the HACCP requirement.
Supplying ketchup to the consumers directly or by retailers (Tk. 50-55/bottle ketchup)

Labeling and packing
6 bottle ketchup
(340 g* 6)

Filling and cooling
(2240 g)

Adding ingredient and Cooking
(2240 g)

Preservation with chemical treatment
(800 gm)

Preparing tomato pulp or Pulping
(800 g)

Preparing of tomato
(900 g)

Fresh tomato from
Market (1 kg)

Sugar: 400g
Water: 500g
Onion: 240g
Spices: 300g

Diagram 4.3 Processing of tomato ketchup from fresh tomatoes
Flow Chart of Tomato Pulp

6°C
4°C

Store in cold storage

Filling

S.S tank with Agitator
Add the preservatives
Citric acid as required
pH-3.5-4

Blending

Vacuum Evaporator

Initial tank

Storage tank

Refiner

Crushing

Hopper

Evaporator

Washing

Weighing

Sorting

Feeding

Received

50°C
45°C

Control Points

- hand gloves, musk
- cap, apron, preserv
- drum, lid wash
- two layer polythene use
- weighing
- tag card

- Steam pressure starting 6.88psi running-35.55-42.66 psi
- steam temperature (98-102 degree c)
- vacuum pressure-20- 25 inch/Hg
- product temp. (66- 70 degree c)
circulated water temp 35-40 degree c
- final brix-(14-16 degree)

- add preservatives

- dark particles
- seed & skin removed

- S. S Sheet

- hot water

- normal water

- balance calibration

- rotten, -bruised & -off specified quality

- sound ripeness
- variety, hybrid/deshi
4.4.3 Adding ingredients and cooking

The pulp is pumped into cooking tanks or kettles and heated to boiling. Foaming may occur if fresh tomato pulp is used, but can be corrected with anti-foaming compounds or compressed air. Precise amounts of sweeteners, vinegar, salt, spices, and flavorings are added to the tomato pulp. Most spices are added early in the cooking process. To avoid excessive evaporation, volatile spice oils and vinegar must be mixed in later. Onions and garlic can be mixed in with the spices, placed in a separate bag, or chopped and added to the pulp. Salt and sugar may be added at any stage of cooking though it is better to add sugar later to prevent burning. The mixture cooks for 30-45 minutes and is circulated by rotating blades installed in the cookers. The temperature must be carefully regulated to insure absorption of the ingredients without overcooking, which creates a flat body.

4.4.4 Finishing

Once the cooking is complete, the ketchup mixture passes through a finishing machine. Finishers remove excess fiber and particles through screens, creating a smoother consistency. The ketchup passes to a holding tank before further processing. The ketchup may be milled at higher temperatures and pressures to achieve a smoother consistency.

4.4.5 Removing air

The ketchup must be de-aerated to prevent discoloration and growth of bacteria. Excess air might also create unattractive air pockets and impede the closure process.

4.4.6 Filling

To prevent contamination, the ketchup passes from the receiving tanks to the filling machines at a temperature not lower than 88°C. The containers are filled with the
ketchup and immediately sealed to retain the freshness of the product. Ketchup containers come in various sizes and shapes, including 340 gm bottles, No. 6 cans, pouch packs, room-service sizes, and single-serve packets for every 1 kg fresh tomato.

4.4.7 Cooling

The containers must be cooled to prevent flavor loss through stack burning, which occurs when ketchup stays at high temperatures after cooking is complete. Containers of ketchup may be cooled in cold air or cold water.

4.4.8 Labeling and packing

Finally, the ketchup containers are labeled and coded with product information, including ingredients, date and location of manufacture, and shelf-life. The bottled ketchup may be inspected again before shipping. The entire process of ketchup manufacturing generally takes two to three hours.

4.4.9 Quality Control

Some of the commonly used preservatives during the 19th century included benzoate of soda, borax salicylic acid, benzoic, and formaldehyde, all of which could pose health risks when consumed in large quantities. A series of Pure Food Laws beginning in 1979 banned the use of the harmful preservatives.

In 1982, the Bangladeshi government established a "Standard of Identity" for ketchup as tomato-based. Thus, consumers could tell from the label that the product was made of tomatoes, since ketchup could also be made from other foods, including bananas, beets, or mangoes.
The quality of ketchup is insured by taking samples of the product during various stages of production. Tomato growers must comply with regulations set by the Environmental Protection Agency and the Food and Drug Administration regarding the use of fertilizers and pesticides. Increasing concern in the closing decades of the 20th century led to increased use of natural fertilizers and pesticides. Inspection is necessary of the tomatoes, ingredients, and of all processing equipment which comes into contact with the product.

4.5 Value Chain and Value Addition of Tomato Ketchup

The value addition of fresh tomatoes from consumers to city/district market wholesaler/Arotdar was estimated about 80%. The price at producers level was Tk.7/kg and reached to Tk.15/kg at city/district market wholesaler/Arotdar level with an value addition of Tk.8/kg (Diagram 4.4). The ketchup industry collected tomatoes from city/district wholesale market at a price of Tk. 15/kg and added value at different processing activities. The activities include loading, unloading, carrying, grading 0.70%, washing & boiling 0.70%, pulping 1.75 %, preserving 2.10%, pre-process or mixing process 28.07 %, spices 7.01 %, heat treatment 1.75 %, bottles with label 3.5%, packaging 1.75% and profit 52.6% (Diagram 4.5). The total value addition for 1kg of fresh tomato was estimated asTk.285, where price of 1kg tomato and its product (six bottles of tomato ketchup including ingredients) were Tk.15 and Tk. 300, respectively.
Diagram 4.4 Value chain (value addition) of tomato ketchup
CHAPTER V

CONCLUSION AND RECOMMENDATION

5.1 Conclusions

The following conclusions are made, based on the objectives, field observations, results and interpretations of field data:

- The major actors of fresh produce value chain of tomato are identified as tomato producers, local market middlemen/foria, city wholesalers/Arotdar, city/district market retailers and consumers.

- Almost 90% of the total fresh tomatoes are supplied to city/district wholesale markets and the rest 10% of the produce is consumed locally.

- The value addition of fresh tomatoes from consumers to city/district market wholesaler/Arotdar is estimated about 80%. The ketchup industry collects fresh tomatoes from city/district wholesale market and add value in loading, unloading, carrying, grading 0.70%, washing & boiling 0.70%, pulping 1.75 %, preserving 2.10%, pre-process or mixing process 28.07 %, spices 7.01 %, heat treatment 1.75 %, bottles with label 3.5%, packaging 1.75% and profit 52.6%. The total value addition for 1kg of fresh tomato is estimated asTk.285, where price of 1kg tomato and its product (six bottles of tomato ketchup including ingredients) are Tk.15 and Tk. 300, respectively.

- The losses in the post-harvest value chain of fresh produce tomatoes in grading and transportation to local market; long transport, packaging, storage at middlemen (Foria), handling and storage at city/district wholesaler/Arotdar
to tomato ketchup making industry and city/district market retailers are estimated as 13%, 4.5%, 10.8%, 1.35%, and 8.1%, respectively. The total average loss of fresh tomatoes value chain is as much as 36.4%.

- About 30% of total loss of fresh tomatoes can be reduced by processing it to tomato pulp in peak harvesting season of tomatoes. Apart from ketchup production, tomato pulp can be used in various purposes in off seasons that can provide an edge in avoiding losses of fresh tomatoes.

5.2 Recommendations

- The farmers have to maintain balanced harvesting time schedule to avoid harvesting of over and unripe tomatoes.
- To reduce losses, tomatoes have to be transported in plastic casing. Furthermore, plastic casing should be handled carefully to avoid bruising loss.
- For long transport by track bulk loading must be avoided to minimize the total average loss of tomato.
- For easy preservation, fresh tomatoes can be processed into pulp that can reduce the losses of fresh tomatoes in peak harvest.
- For better value addition and flow of benefits to producers, processing of fresh tomatoes would be encouraged.
- Further detail study is needed to identify the appropriate practices for loss reduction in handling, transportation, storage and processing of fresh tomatoes in the value chain.
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APPENDIX-A

(Interview Schedule)

INTERVIEW SCHEDULE

Interviewee: ............................................................. Age: ...................................................

Address: ................................................................. Educational qualification: .................

Number of farmer in tomato cultivation: ........................................ Date: .....................

FOR FARMER

1. What is the area of the tomato cultivated land?

2. What are the amount of tomato production in previous year and the area of land?

3. What was the total tomato production cost in previous year?
   a) Tilling cost
   b) Planting cost
   c) Seedling cost
   d) Fertilizer cost
   e) Maintenance cost
   f) Pesticide and insecticide cost
   g) Irrigation cost
   h) Carrying (Bazar) and labour cost

4. What will be the expected production this year?

5. Where is the place of temporary preservation of tomato after harvesting? Is there any problem in preservation?

6. What is the amount of tomato carrying to Bazar for selling (Daily/Weekly) and selling price of tomato and benefits?

7. What is the type of box, carrying vehicles and which option use to tomato handling and there any problem?

8. What is the carrying and labour cost?

9. What is the amount of tomato damages and how it is occurred in production upto selling (transporting, packaging and handling)?

10. What is the type of damages and why it is done and how it is reducing?

11. What is the symptom of tomato damages (diseases, bruising etc.)?
APPENDIX-B
(Interview Schedule)

Interviewee: ................................................. Age: .................................................
Address: ........................................................ Educational qualification: ..............
Date: ..............................

For Wholeseller/Foria/Godwan Manager Super/Market Manager/Middle Man

1. What is the buying and selling price per kg of tomato and what is the benefit?

2. What is the amount of tomato buying and selling (daily/weekly)?

3. Who are the tomato suppliers and their carrying type and where you selling?

4. What is the process of tomato preservation and where you preserved and is there any problem?

5. What is the type of preservation box, carrying vehicle and the type of process in tomato handling and is there any problem?

6. What is the amount of carrying and labour cost?

7. What is the total amount of tomato damages and how it’s occur?

8. What is the type of tomato damages and why does it occur and how it is reduced?

9. What is the indicator to identify good and rejected tomato and the type of separation?