Identification of requirements for implementing Food Safety Management System (ISO 22000:2005) to the carbonated beverage process at Shaa Cola Beverages (Pvt) Ltd.

By

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DECLARATION

The work described in this thesis was carried out by me at the Department of Food Science & Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, under the supervision of Mr. A.L.C.J. Liyanage, Lecturer, Department of Food Science & Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka & Mr. A. Wanasinghe, Operational Manager, Shaa Cola Beverages (Pvt) Ltd, Moragahahena, Horana. A report on this has not been submitted to any other university for another degree.

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Affectionately

Dedicated

To

My Parents, Teachers

&

My Alma mater

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ABSTRACT

As food organizations which thrive in competitive market context, product quality is one of the most important factor to be considered at strategic decision making process. Thus the food safety management system has become necessary rather than the quality management system which is widely implemented in all sectors but does not itself specifically address food safety. ISO 22000:2005 is therefore designed to allow all types of organizations within the food chain to implement a food safety management system.

The present study was focused on the setting up of preliminary requirements for the implementation of food safety management system (ISO 22000:2005) to the carbonated beverage process at Shaa cola beverages (Pvt) Ltd.

As the first step; scope, food safety policy and related objectives were defined and Prerequisite Programs (PRPs) were developed by studying the carbonated beverage production flow beginning from raw material reception to transportation of the finished product. Critical Points (CPs) and Critical Control Points (CCPs) were determined by identifying all the food safety hazards associated with production process and assessing those hazards using risk assessment matrix and decision tree. Then Operational Prerequisite Programs (OPRPs) and Hazard Analysis Critical Control Point (HACCP) plan were established and documented. Process capability analysis was done for validation of food safety management system. Verification and continuous improvement procedures of food safety management system were also developed.

PRPs were developed for calibrations, cleaning and sanitizing, personal hygiene, pest control, supplier assessment, waste and sewage disposal and water, air and energy supply. Raw material receiving, ingredient weighing, sugar dissolving, sugar filtration, water filtration, carbonation and finished product storage were identified as CPs and raw material receiving and inspection, syrup room management, carbonated process management, filtration process management and finished product inspection were established as OPRPs to monitor the CPs. UV sterilization and bottle capping were identified as points that need to be critically controlled and HACCP plan was developed. Addressing those according to the process capability analysis; cola, mandarin and cream soda production processes were identified as barely acceptable processes and soda as well as lemonade production processes should be improved according to their specifications. Food safety plan and internal audit plan were developed as verification procedures of food safety management system

It is further expected to conduct a gap analysis to evaluate the successful implementation of ISO 22000:2005 to the carbonated beverage process.

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LIST OF ABBREVIATIONS

ADI	Acceptable Daily Intake
APC	Aerobic Plate Count
CPs	Critical Points
CCPs	Critical Control Points
CIP	Cleaning In Place
CLs	Critical Limits
Codex	Codex Alimentarius Commission, an FAO/WHO Organization
EEC	European Economic Community
ESCF	European Standing Committee on Food
FAO	Food and Agricultural Organization
FDA	Food and Drug Administration
FIFO	First In First Out
FSMS	Food Safety Management System
GRAS	General Recognize As Food
HACCP	Hazard Analysis Critical Control Points
ISO	International Organization for Standardization
ISO/TS	International Organization for Standardization/Technical Specification
JECFA	Joint Expert Committee on Food Additives
MR	Management Representative
MRM	Management Review Meeting
NCR	Non Conformity Records
OPRPs	Operational Prerequisite Programs
PET	Poly Ethylene Tetraptheline
PRPs	Prerequisite Programs
QAM	Quality Assurance Manager
SLS	Sri Lankan Standards
SQA	Supplier Quality Assurance
UV	Ultra Violet
WHO	World Health Organization

CHAPTER 01

Introduction

1.1 Introduction

In order to complete the global picture, food organizations in competitive market context, the product quality is one of the most important factor to be consider at strategic decision making process. Food reaches consumers via supply chains that may link many different types of organization and that may stretch across multiple borders. One weak link can result in unsafe food that is dangerous to health and when this happens, the hazards to consumers can be serious and the cost to food chain suppliers considerable. As food safety hazards can enter the food chain at any stage, adequate control and communication throughout is essential. Food safety is a joint responsibility of all the actors in the food chain and requires their combined efforts.

Further development of Socio-economical, Educational and changes in consumer habits forces the food companies to produce safe products that give minimum harm effect to its consumers. The standard has become necessary because of the significant increase of illnesses caused by infected food in both developed and developing countries. In addition to the health hazards, food borne illnesses can give rise to considerable economic costs covering medical treatment, absence from work, insurance payments and legal compensation.

Since industry develops, the International Organization of Standardization (ISO) standards become an essential tool to reach the consumers as they more aware of those standards and may tend to choose them more. The food safety management system (ISO 22000:2005 standard) has become necessary rather than the quality management system (ISO 9001:2000) which is widely implemented in all sectors but does not itself specifically address food safety.

ISO 22000 is therefore designed to allow all types of organization within the food chain to implement a food safety management system. These range from feed producers, primary producers, food manufacturers, transport and storage operators and subcontractors to retail and food service outlets together with related organizations such as producers of equipment, packaging material, cleaning agents, additives and ingredients.

ISO 22000 combines the Codex Alimentarius HACCP (Hazard Analysis and Critical Control Points) principles and application steps, developed by Codex Alimentarius, with prerequisite programmes. The development of ISO 22000 was based on the assumption that the most effective food safety systems are designed, operated and continually improved within the framework of a structured management system, and incorporated into the overall management activities of the organization. It is applicable to all organizations, regardless of size, which are involved in any aspect of the food chain and want to implement systems that consistently provide safe products (Faergemand and Jespersen, 2004).

Carbonated beverage is an effervescent drink that releases carbon dioxide under conditions of normal atmospheric pressure. Production of carbonated soft drinks started with pure source of water and carbon dioxide, flavours, preservatives, colours are use for complete the production. Most of the people tend to consume carbonated beverages due to its thirst quenching property (Mitchell, 1990).

Shaa Cola Beverages (Pvt) Ltd is one of the subsidiary company of Jaycey group and it was set up in year 2006. Company engaged in the process of manufacturing range of carbonated beverages including soda, cream soda, cola, mandarin, tamarind, lemonade, etc. which are marketed under the brand name "Shaa". They incorporate some of the fully automated modern machinery with high technology, such as carbonation, filling and capping machines.

At present, Shaa Cola Beverages (Pvt) Ltd is trying to become a Sri Lanka's market leader in the carbonated beverage industry by supplying safe food products with an affordable price to the market. To achieve the company goal, implementing food safety management system (ISO 22000:2005) is a mandatory requirement due to its combination of HACCP (Hazard Analysis Critical Control Points) principles and application steps with prerequisite programmes.

This project work attempts to set up preliminary requirements for implementation of ISO 22000:2005; food safety management system to the carbonated beverage process in line with its existing processes.

1.2 Overall objective:

Setting up of preliminary requirements for the implementing Food Safety Management System (ISO 22000:2005) to the carbonated beverage process.

1.3 Specific Objectives:

1. To define the scope, food safety policy and related objectives associated with the company.

2. To develop Prerequisite programs (PRPs) for the company.

3. To identify of all potential food safety hazards associated with the carbonated beverage process and establish Operational prerequisite program (OPRPs) and Hazard Analysis Critical Control Point (HACCP) plan and there by specifying control measures.

4. To prepare documentation for the implementation of Food safety management system (ISO22000:2005) to the carbonated beverage process.

CHAPTER 02

Literature Review

2.1 General Overview

2.1.1 International Organization for Standardization

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International standards is normally carried out through ISO technical committees. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International standard requires approval by at least 75% of the member bodies casting a vote (ISO 22000:2005(E)).

Increased demand for International Standards due to;

- Globalization of trade in products and services.
- Outsourcing and foreign investment.
- Deregulation/privatization of public services.
- The climate change challenge and energy efficiency mandates.
- Public demand for consumer safety, environmental protection, corporate social responsibility.
- Need for international solidarity to face global terrorism, pandemics and natural disasters.
- Pace of innovation and convergence of new technologies.

2.1.2 ISO 22000

ISO 22000 does not follow an exhaustive and prescriptive checklist approach; instead the standard allows an organization to develop a food safety management system tailored to its particular suppliers, customers and relevant parties.

2.1.3 ISO 22000 family of standards

Four Standards so far:

ISO 22000:2005 – Food safety management system – Requirements

ISO 22003:2007 - Requirements for bodies providing audit and certification of food safety management systems

ISO TS 22004:2005 - Guidance on the application of ISO 22000

ISO 22005:2007 – Traceability in the feed and food chain

(McKinley and Chambers, 2007).

2.1.4 ISO 22000:2005 - Food Safety Management System – Requirements

ISO 22000:2005 specifies requirements for a food safety management system where an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption. The standard builds on generally accepted principles for food safety in the food chain and focuses on identifying and preventing food safety hazards through PRPs (Pre-Requisite Programs) and HACCP (Hazard Analysis and Critical Control Points) plans. It promotes communication, continual improvement and management and updating of the food safety management system (ISO 22000:2005(E)).

2.1.5 Benefits of ISO 22000:2005

Obtaining ISO 22000:2005 compliance will yield the following benefits to the company.

- A systematic approach to identification of food safety hazards, which in turn aids in the development and implementation of proactive control measures.
- Marketing advantage - increased business
- Improved efficiency and profitability
- Increased customer satisfaction
- Documented system provides useful reference
- Improved records in case of litigation
- Responsibilities of personnel clearly defined
- Improved control during periods of change or growth
- Improved communication on food safety issues
- Improved performance from suppliers
- Increased customer satisfaction
- Closes the gap between ISO 9001 and HACCP
- Meets food industry expectations
- Based on system management, not on inspections or a product approach
- Provides an opportunity for international recognition through 3rd party registration
- Makes savings from fewer customer audits possible
- Provides a baseline for the entire food chain (Lab alert: ISO 22000)

2.2 Key elements of ISO 22000:2005

ISO 22000 identifies the following four 'pillars' of a food safety management system.

2.2.1 Interactive communication

Communication along the food chain is essential to ensure that all relevant food safety hazards are identified and adequately controlled at each step within the food chain. This implies communication between organizations both upstream and downstream in the food chain. Recognition of the organization's role and position within the food chain is essential to ensure effective interactive communication throughout the chain in order to deliver safe food products to the final consumer (ISO 22000:2005(E)).

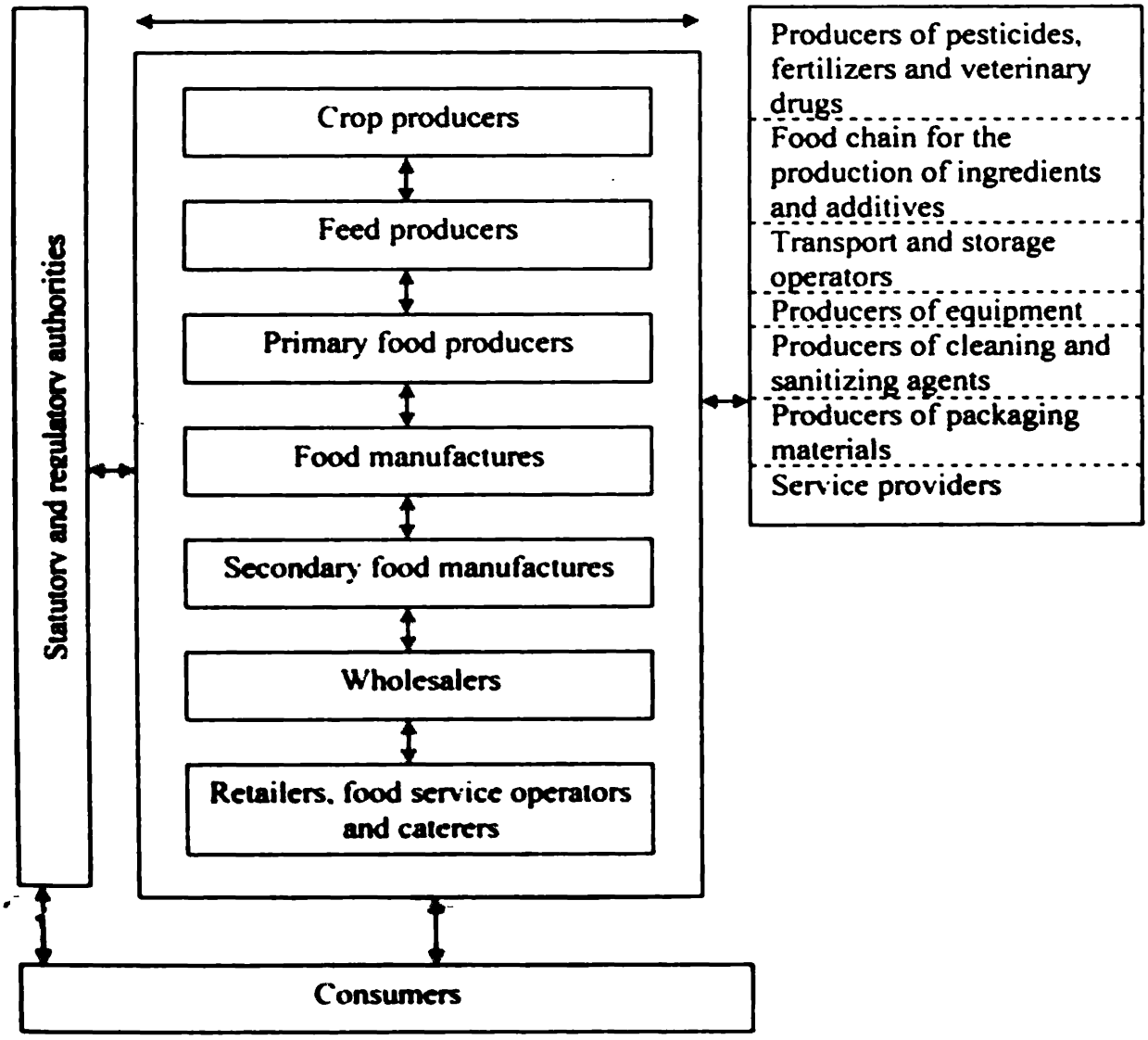

Fig. 2.1: Model of communication within the food chain (Source:ISO 22000:2005(E))

2.2.2 System management

The most effective food safety systems are established, operated and updated within the framework of a structured management system and incorporated in to the overall management activities of the organization. This provides maximum benefit for the organization and interested parties. Food safety management system has been aligned with ISO 9001 quality management system in order to enhance the compatibility of two standards.

2.2.3 Prerequisite programs

Prerequisite programs (PRPs) must be in place and fully operational before the HACCP is in place .The PRPs needed depend on the segment of the food chain in which the organization operates and the type of organization. These program must be implement adequate and effectively in the process. By application of those able to control the number of CPs and CCPs occur in the process unnecessarily. Some examples are personal hygiene, cleaning and sanitation, waste and sewage disposal etc (ISO 22000:2005(E)).

2.2.4 HACCP Principles

ISO 22000:2005 is based on the Hazards Analysis and Critical Control Point (HACCP) principles that have international acceptance and details of the approach have been published by the Codex Alimentarius Commission to identify, prevent and control food safety hazards.

Principle 1: Conduct a hazard analysis

Principle 2: Identify Critical Control Points (CCPs)

Principle 3: Establish critical limits

Principle 4: Establish CCP monitoring requirements

Principle 5: Establish corrective actions

Principle 6: Establish record keeping

Principle 7: Establish procedures for verification to determine the effectiveness of HACCP system (Mortimore and Wallace, 1998).

2.3 ISO 22000:2005 as a process approach

For an organization to function effectively and efficiently, it has to identify and manage numerous linked activities. An activity using resources, and managed in order to enable the transformation of inputs in to outputs, is considered as a process. Often the output from one process directly forms the input to the next.

The application of a system of processes within an organization, together with the identification of interactions and the management of these processes can be referred to as the "process approach". An advantage of the process approach is the ongoing control that it provides over the linkage between the individual processes within the system of processes as well as their combination and interaction.

When used within a food safety management system, such an approach emphasizes the importance of

- Understanding and fulfilling the requirements
- The need to consider processes in terms of food safety and traceability
- Obtaining results of process performance and effectiveness and
- Continual improvement of processes based on objective measurement

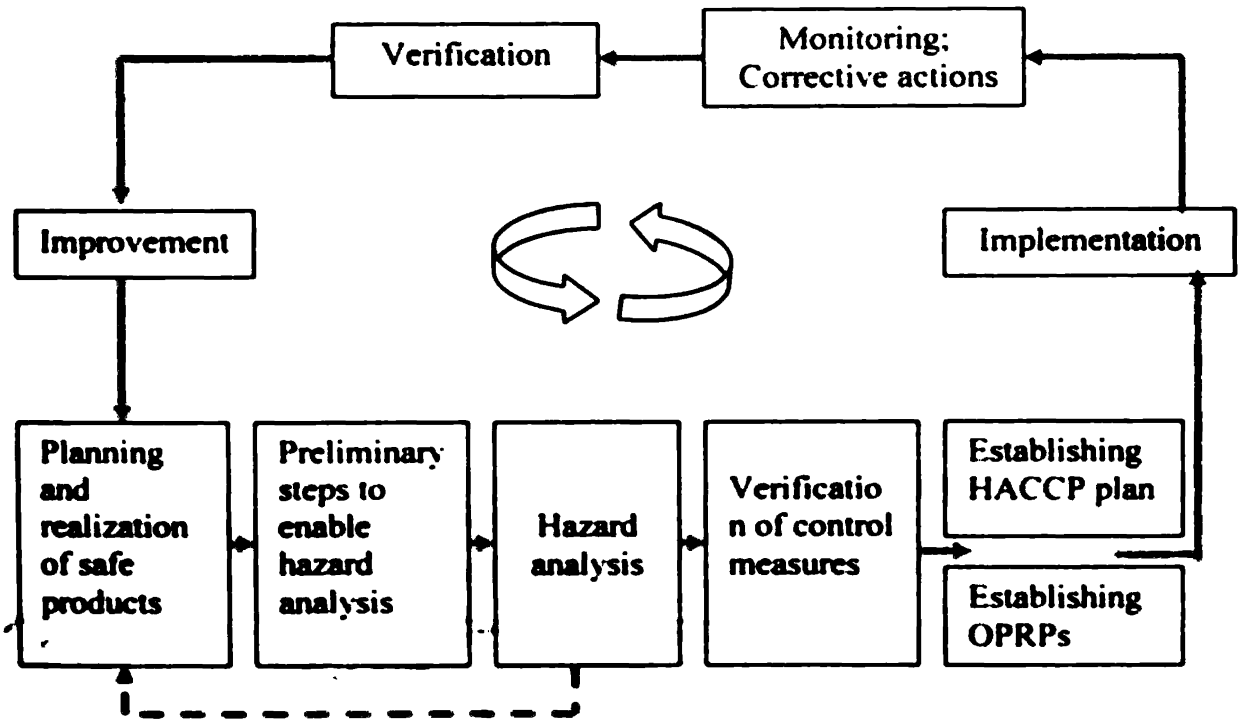

Fig. 2.2: The model of a process-based food safety management system (Source: ISO/TS 22004:2005(E))

2.4 ISO 22000:2005 – Food safety management system

2.4.1 Requirements

2.4.1.1 General requirements

The organization defines the scope of the food safety management system that is specify the product or product categories, process and production sites that are address by the food safety management system. Also ensure that food safety hazards are identified, evaluated, controlled in such a manner, communicate appropriate information.

2.4.1.2 Documentation requirements

A food safety management system needs to be documented. The organization must have, as a minimum, a written food safety policy and related objectives, the procedures and records required by ISO 22000 and any other documents that need to ensure the effective development, implementation and updating of the system.

Fig. 2.3: Documentation requirements hierarchy of food safety management system (Source: ISO 22000: UNCTAD/WTO 2007)

2.4.2 Management responsibility

2.4.2.1 Management commitment

Top management's commitment is critical to the successful implementation of the food safety management system. The system costs time and money to develop, implement and maintain. It will directly involve top management it self in allocating resources and in decision making at key steps in the process, its maintenance and updating.

2.4.2.2 Food safety policy

The overall food safety policy should be short and tightly focused, because it is a key benchmark for food safety management system. So top management needs to be involved in its development and clearly committed to its implementation. Food safety policy should speak directly to employees, as a vital part of training.

2.4.2.3 Food safety management system planning

The plan should identify the business objectives to be met by the system, set out the resources required and identify measurable objectives. Therefore planning is critical to the development, implementation and updating of a food safety management system by top management.

2.4.2.4 Responsibility and authority

ISO 22000 statuses that top management must ensure that the specific responsibilities and authorities needed for the establishment of the food safety management system are formally defined and communicate to all employees within the organization. The process of establishing relevant job descriptions contributes to the achievement of specific food safety management system objectives that were set for relevant functions and levels within the organization.

2.4.2.5 Food safety team leader

ISO 22000 statuses that the responsibility and authority for the food safety management system must be assigned to one person. ISO 22000 identifies that person as the food safety team leader, appointed by top management. The team leader should be a member of the organization and have a basic knowledge of hygiene management, the application of HACCP principles and the requirement of ISO 22000.

2.4.2.6 Communication

Communication should ensure that the necessary interactions occur within the organization and along the food supply chain. External communication should ensure that any relevant hazards are controlled at the appropriate steps in the food chain. Internal communication is just as important as external communication in ensuring that the organization's system is effective.

2.4.2.7 Emergency preparedness and response

ISO 22000 says top management must be prepared to respond to potential food emergency situations and accidents that can impact on food safety. These can include incidents such as fire, flooding, bio-terrorism and sabotage, energy failure, vehicle

accidents, contamination of the environments and various types of weather related events.

2.4.2.8 Management review

Management must review the food safety management system to ensure its continuing suitability, adequacy and effectiveness. The review also facilitates the assessment of opportunities for improvement and the need for change to the system, including the food safety policy. This review should take place at planned intervals. In the early stages of implementation, these intervals may be shorter than when the system is mature.

2.4.3 Resource management

A variety of resources will be required by every organization establishing, implementing, maintaining and updating a food safety management system. These include human resources, infrastructure and an appropriate work environment.

2.4.4 Planning and realization of safe products

To realize safe food products, an organization needs to plan and develop the necessary processors. These will include prerequisite programmes (PRPs), operational prerequisite programmes (OPRPs) and the HACCP plan.

2.4.4.1 Prerequisite programmes (PRPs)

PRPs are the basic conditions and activities that are necessary to maintain a hygienic environment throughout the food chain suitable for the production, handling and provision of safe end products. When implemented PRPs assist in controlling the likelihood of introducing food safety hazards, biological, chemical or physical contamination of products and any increase in the levels of these hazards in the product or the processing environment. They need to be appropriate to the products and processes of the organization, approved by the food safety team and implemented.

2.4.4.2 Hazard analysis

The development of a food safety management system involves the rigorous application of a hazard analysis. This process involves a number of preliminary steps and rigorous decision making process. The steps and principles involved in this process have been outlined by the Codex Alimentarius Commission (ISO 22000:2005(E)).

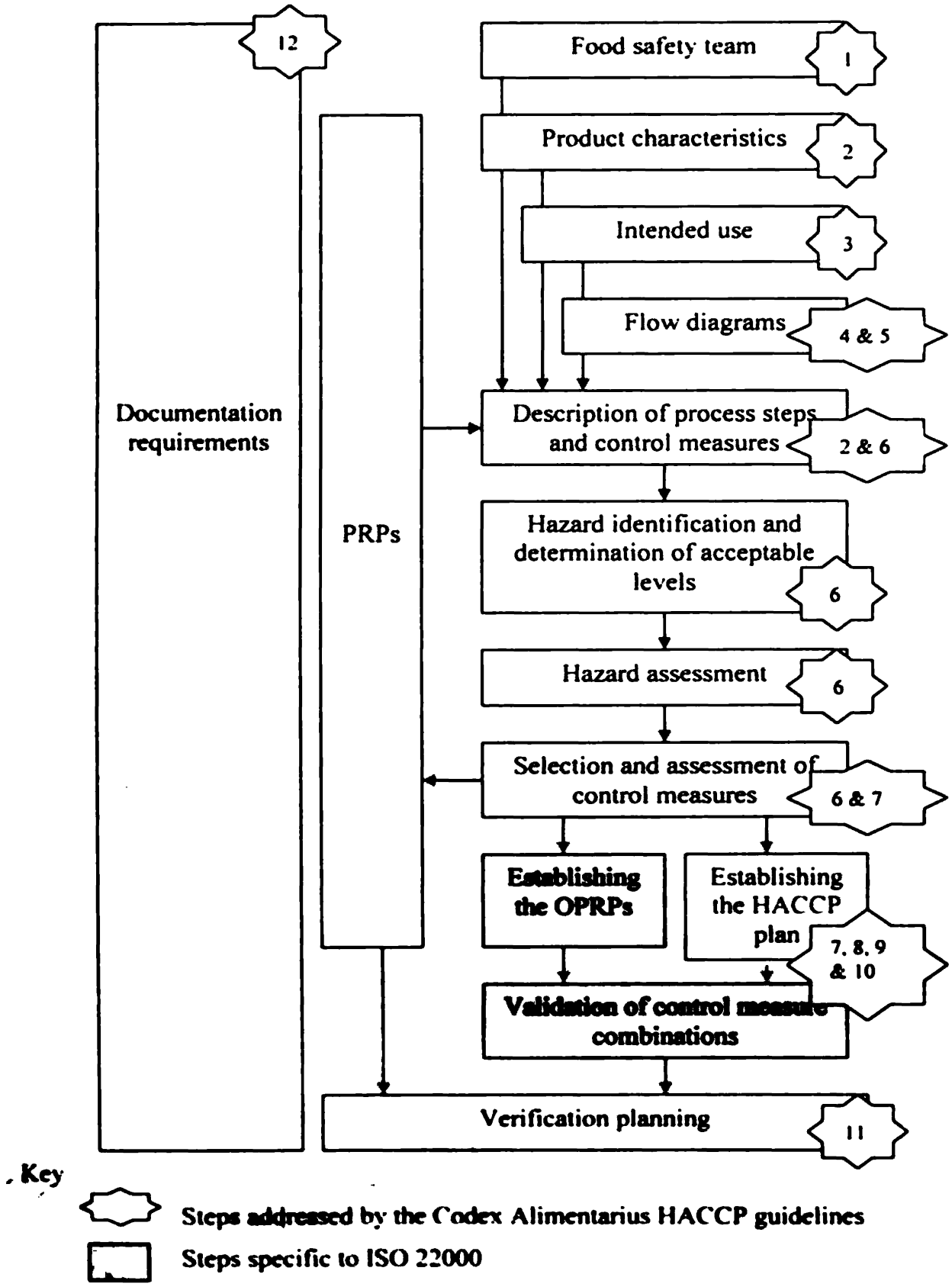

Fig. 2.4: Steps of the ISO 22000 approach to hazard analysis

(Source: ISO/TS 22004:2005(E))

Preliminary steps to enable hazard analysis

- Food safety team

  The food safety team is a combination of multi-disciplinary, knowledge and experience in developing and implementing the food safety management system.

- Product characteristics

  All raw materials, ingredients, product contact materials and characteristic of end products are described to the extent needed to conduct the hazard analysis.

- Intended use

  Intended uses are group of uses or appropriate group of consumers for each product. They are end uses, general public, sensitive population, infant, pregnant mothers, elderly people, sick people, etc.

- Flow diagrams

  Flow diagrams are prepared for the products or process categories covered by the food safety management system. It is a clear, accurate and sufficiently detailed diagram providing a basis for evaluating the possible occurrence, increase or introduction of food safety hazards (Boutou, 2008).

2.4.4.3 Hazard identification and determination of acceptable levels

Food safety hazard: A biological, chemical or physical agent in food, or conducting of food with a potential to cause an adverse health effect.

- **Biological hazards: pathogenic bacteria, fungi, viruses, parasites, etc**
- **Chemical hazards: Intentional additives:- colours, flavours, preservatives**
  Unintentional additives: - cleaning chemicals
  Natural toxins: - seafood, mushrooms
- **Physical hazards: foreign matters such as glass, stones, jewelleries, metals, etc**

Acceptable level means the level of an identified hazard in the end product of the organization that is needed at the next step in the food chain to ensure food safety; it refers to the acceptable level in foods for direct consumption only when the next step is actual consumption (Mortimore and Wallace, 1998).

2.4.4.4 Hazard assessment

A hazard assessment is conducted to determine, for each food safety hazard identified whether its elimination or reduction to acceptable levels is essential to the production of a safe food, and whether its control is needed to enable the defined acceptable levels to be met.

2.4.4.5 Establishing operational prerequisite programmes (OPRPs)

OPRP is a Prerequisite programme identified by the hazard analysis as essential in order to control the likelihood of introducing food safety hazards to and/or the contamination or proliferation of food safety hazards in the product(s) or in the processing environment.

2.4.4.6 Establishing HACCP plan

HACCP plan is a document prepared in accordance with the HACCP principles to ensure the control of hazards, which are significant for food safety in the segment of the food chain under consideration.

2.4.5 Validation, verification and improvement of the food safety management system

- **Validation**

Validation is obtaining evidence that the control measures managed by the HACCP plan and by the Operational PRPs are effective and capable of achieving the intended control of the food safety hazard.

- **Control of monitoring and measuring**

It is a procedure to detect any failures in the control measures. Organization provides evidence that the specified monitoring methods and measuring equipments are adequate to ensure the expected performance.

- **Verification**

Verification is an assessment carried out during and after the operation, to demonstrate that the intended level of control is actually been achieved. Organizations are carried out internal audit programs at planned intervals for verification process

- **Improvements**

Top management ensure that the organization continually improves the effectiveness of the food safety management system through the use of communication, management review, internal audit, etc (ISO 22000:2005(E)).

2.5 Carbonated Beverages

Carbonated nonalcoholic beverages are generally sweetened, flavored, acidified, coloured, artificially carbonated and some times chemically preserved beverage that contains the characteristic of carbonation.

Their origin goes back to Greek and Roman times when naturally occurring mineral waters were prized for 'medicinal' and refreshing qualities. But it was not until about 1767, when the British chemist Joseph Priestley found that he could artificially carbonated water, that the carbonated beverage industry got its start. An early method of obtaining the carbon dioxide was by acidification of sodium bicarbonate or sodium carbonate, and from the use of these sodium salts came the name "soda" which remains today, although most carbon dioxide is no longer generated in this fashion. Generally, fruit juices and extracts were added to carbonated water for improved flavour (Hotchkiss and Potter, 1996).

2.5.1 Raw materials

- **Water**

Water is the principal ingredient in carbonated beverage production, and regular soft drinks contain 90% water while diet soft drinks may contain up to 99% water. Water must be free from suspended matters, colouring matters, objectionable odours and minerals which may interfere with the flavour and colour of the soft drink. The alkalinity of beverage water must be low to prevent neutralization of the acid used in the beverage, which would alter flavour and decrease the preservative property of the beverage.

- **Sugar**

Sugars used in carbonated soft drinks can be divided in to those in a dry, granular form and those in a liquid or syrup form or in certain circumstances, wheat (glucose syrup/high fructose glucose syrup). Granulated sugar is a dry crystallized extracted from sugar beet and sugar cane called sucrose that gives the caloric value to the beverage.

- **Carbon dioxide**

Carbon dioxide (CO_2) is a colourless gas with a slightly pungent odour; when dissolved in water the resultant carbonic acid mixture has an acidic and biting taste which is not unpleasant. Also CO_2 is one of the very few gasses suitable for providing

the effervescence in soft drinks. It is non-toxic, inert, virtually tasteless, and readily available at moderate cost and may be liquefied at reasonable temperatures and pressures, allowing convenient bulk transportation and storage.

- **Flavourings and emulsions**

Natural flavourings, nature identical flavourings and artificial flavourings are used as flavouring agents for soft drink production. The type of flavouring agent used will depend upon the finished drink required. Although flavourings are normally used in extremely small quantities in a carbonated soft drink, their impact can make the difference between a tasty product and one that is bland and uninteresting. If follows, therefore, that many flavourings are highly concentrated and their application dose rate must be optimized with great care.

As emulsion is a dispersion of one liquid in another in which it would not normally be miscible. The main use of emulsion in carbonated soft drinks is as a clouding agent. When considering the organoleptical features of a soft drink, the visual appearance is extremely important as the 'eye appeal' can often be the determining factor in deciding which drink is actually purchased.

- **Acids, colours, preservatives and other additives**

The main reasons for acidification are, to enhance beverage flavours (sharpness to the background taste), to enhance to the thirst quenching experience by stimulating saliva flow and to act as a preservative against microbial growth. The principle acids used are phosphoric, citric, fumaric, tartaric and malic acids. Among this citric acid being the most widely used.

Some important colouring agents for carbonated beverages are the synthetic colours which have been approved by FAD or natural colours. Colours affect the psychological impression of beverage. Caramel colour (E150) from heated sugar (natural colour) is commonly used in dark beverages such as colas. Sunset yellow (E110), tartezine (E102) like synthetic colours use for orange, lemon like carbonated beverage production.

A preservative can be defined as any substance that is capable of inhibiting, retarding or arresting the growth of micro-organisms or any deterioration of food due to micro-organisms or of masking the evidence of any such deterioration. Most commonly use sodium benzoate, sodium citrate, potassium sorbate, ascorbic acid like preservatives for beverage production.

- **PET bottles**

PET bottles have provided the carbonated beverage industry with a package which is able to deliver to the consumer volumes of product above the glass bottle's practical limit of 1 litre in a single container and have therefore contributed strongly to the overall growth in the industries volume in the 1980s. It is rare for PET bottles to break and even when breakage does occur, no sharp fragments are produced. The light weight of PET bottles is also an obvious attraction (Mitchell, 1990).

2.5.2 Production process

2.5.2.1 Water treatments

Beverage manufacturer pay particular attention to the quality of the water used in their formulation, to ensure that when the product arrives at the consumer it is consistent in taste and appearance and has not deteriorated during storage. Some of the impurities found in water can have a significant effect upon the quality of the final carbonated product.

Table 2.1: Effect of impurities in water on the quality of the product.

Impurity	Effect on product	Treatment process
Suspended particles	Foaming at the filler. Loss of carbonation. Visible particles in product.	Filtration or coagulation and filtration
Organic matter	Deposits or precipitation in product. Formation of neck rings during storage.	Coagulation and chlorination.
Bacteria	Spoilage by creation of off tastes. Great danger of health risks.	Chlorination or Ultraviolet radiation
Taste and odour due to organic compounds	Off-tastes	Chlorination or absorption by activated carbon
High alkalinity	Neutralizes acidity. Creates a bland taste	Coagulation,Dealkalization by iron exchange
Nitrate	Health hazard	Iron exchange
polysaccharides	Precipitation in storage	Reverse osmosis

(Source: Mitchell, 1990)

- Water filtration

Normally use sand filters and activated carbon filters. Fine particles of floc will be removed by filtration through a sand filter. The activated carbon will be housed in a pressure filter which is similar in construction and arrangement to the sand filter. Using the activated carbon filter will remove all the free chlorine from the water and also remove other organic molecules.

- Sterilization

Most food and beverage industries use ultraviolet (UV) sterilized water that is acceptable for their process applications. The advantage of UV sterilization is that it is immediate, and as it does not require a long incubation period. The wave length of the ultraviolet rays can be selected so that not only are bacteria eliminated but naturally occurring organic matter can also be destroyed. The sterilization reaction is very rapid, meaning that the plant is compact and may be sited close to the point of use, ensuring that the only water that is sterilized is that to be used for beverage production (Mitchell, 1990).

2.5.2.2 Sugar dissolving and filtration

The operation of sugar dissolving system requires a quantity of water to be added to the vessel before the addition of the granulated sugar such that, after dissolution, a brix slightly higher than required is produced. After assessing the precise concentration of the liquid sugar produced, dilution with water is then carried out to give the required level. It is prudent to initially 'over-brix' in this manner because of the practical difficulties involved in adding extra sugar if too dilute a liquid sugar is produced.

The levels of extraneous matter in dissolved sugar are of particular concern because of their effect on the appearance of the final products and the possibility of loss of carbonation if excessive sites of nucleation are present. Filtering before dispatch thus minimizes the above problem. Micro-filtration is a safe and efficient method of removal of unwanted particles and other turbidity components.

2.5.2.3 Mixing ingredients

The dissolved sugar and flavour concentrates are pumped and carefully mixed (too much agitation can cause unwanted aeration). The syrup may be sterilized while in the tanks, using ultraviolet radiation or flash pasteurization which involves quickly heating and cooling. The water and syrup are carefully combined by sophisticated

machines called proportioners which regulate the flow rates and ratios of the liquid. Fixed proportions of syrup and water then pass to the carbonator.

2.5.2.4 Carbonation, filling, capping, labeling and packing

Carbonation is the impregnation of a liquid with carbon dioxide gas (CO_2). When applied to a soft drink product, the result is a beverage which sparkles and foams as it is dispends and consumed. This escape of CO_2 during consumption of the drink should complement and enhance the flavour, and will add an exciting tingle that stimulates the palate.

Each soft drink formulation requires a particular degree of carbonation. So that the effervescence is appropriate to the flavour and nature of the beverage. Fruit drinks- such as orange, bitter lemon, etc. - should contain low levels of carbonation where as juice based drinks- colas, ginger beer and cream soda – should be in the medium to high range of CO_2 content.

Normally filling done by automated filling machine. When filling the product is transferred in to glass bottles or PET bottles or cans at extremely high flow rates. The containers are immediately sealed with pressure resistant closures. Then bottles were sprayed with warm water and dry well because soft drinks are generally cooled during manufacturing process. Finally labels are fixed and containers are packed in to cartons for distribution.

2.6 Micro-organisms and soft drinks

Because of their utilization of sugars to produce alcohols and carbon dioxide, yeasts are of more immediate concern. Yeasts, moulds and bacteria can bring about deterioration in flavour, producing taints, off-notes, differences in mouth feel, etc. most yeast can grow with or without oxygen, where as some bacteria cannot survive in it. Most yeast thrive at temperatures between 25 and 27 ^{0}C; some can survive over 70 ^{0}C and others can exist, apparently quite comfortably, at 0-10 ^{0}C. Bacteria exhibit similar characteristics, with the optimum growth temperature being 37 ^{0}C.

Micro-organisms require nutrient media to enable growth. The range depends upon the individual organisms but apart from water, as the environmental necessity, typical requirements are sources of carbon (carbohydrates), nitrogen (amino acids), phosphorus (phosphates), potassium, magnesium, calcium (mineral salts) and traces of other minerals, e.g. sulphur, iron, cobalt and even vitamins.

Because of the obvious link with protein formation during cell growth, the presence of combined nitrogen is of particular importance. Also where introduced to beverages via fruit pulp or caramel (colouring), there will be greater susceptibility to spoilage by certain micro-organisms.

It is useful to consider the individual status of a bottled drink. It exists as a unique system that can enhance or inhibit the growth of micro-organisms. Micro-flora, which may be present, will enter a dormant stage while the chances of survival are 'assessed'. Following this lag stage, during which specific micro-flora adapt to their new environment and start to grow, there is a burst of activity during which the population will double it self repeatedly at a steady rate. Waste products and diminishing nutrients will act to slow down this growth.

However, in practical terms the drink, while not necessarily a health hazard, no longer exhibits those qualities intended by its formulation (Mitchell, 1990).

2.7 Carbonated Beverages and Food safety issues

The commercial success of a soft drink formulation depends upon a number of factors such as appearance, taste like things. Not only that but also safety of the drink is very important factor. To produce safe carbonated beverage product, each and every ingredient should have a typical use level (Table 2.2).

Table 2.2: Components of a carbonated soft drink

Component	Typical use level	Contribution
Water	Up to 94% v/v	Bland carrier solvent for other ingredients
Sugars	7 - 12 % m/v	Sweetness, body, balance to flavour
Carbon dioxide	0.3 - 0.6 % m/v	Provides mouth-feel and 'sparkle' to drink
Acids	0.05 - 0.30 % m/v	Sourness, sharpness background to flavour; increases thirst quenching effect
Flavours Nature identical & artificial Natural	 0.1 - 0.28 % m/v up to 0.5% m/v	Provides flavour character and identity to the drink
Emulsion	0.1% v/v	Produces cloudiness
Colour	0-70 ppm	Standardizes and identifies colour tone of

		drink
Preservatives	Statutory limits generally apply, e.g.; SO_2 70 ppm, benzoic 160 ppm	Restrict microbial attack and prevent destabilization
Anti-oxidants	< 100 ppm	Limits flavour and colour deterioration owing to oxidation
Vitamins/minerals	ADI applies	Nutritional requirements

(Source: Mitchell, 1990)

Both EEC and FDA have published list of colours that are under regular review. Some colours are shown in Table 2.3.

Table 2.3: Some colours used in soft drinks

Colour	E number
Carmine	E120
Caramel	E150
Quinoline Yellow	E104
Tartrazine	E102
Sunset Yellow	E110
Ponceau 4R	E124

(Source: Mitchell, 1990)

Defined maximum levels for named preservatives are given according to the food substrate; in the case of soft drinks for consumption without dilution, the UK regulations read as follows (Table 2.4).

Table 2.4: maximum levels of preservatives

Preservative	mg/kg	E number
Sulphur dioxide	70	E220
Benzoic acid	160	E210
Ethyl 4-hydroxy benzoate	160	E214
Propyl 4-hydroxy benzoate	160	E216
Sorbic acid	300	E200

(Source: Mitchell, 1990)

2.7.1 The safety of food additives

To ensure the carbonated product reaches the consumer in a satisfactory state, it is necessary to create a balanced blend of component parts that will remain predictably sound during retail shelf-life for at least twelve months, under recommended storage conditions. To some, 'component parts' are synonymous with 'additives', a term which often provokes concern, but it must be emphasized that food additives receive official approval only if toxicological testing in the light of current knowledge yields no signs of harmful effects, nor any reason to suspect that harmful effects may arise.

The safety of food additives is tested according to guidelines issued by the joint committee of JECFA, WHO and FAO. Knowledge of health safety is gained primarily in animal experiments. In later stages of testing, humans may also be included in the studies to ascertain that their physiological reactions are similar to those found in animals.

Because of potentially longer term ingestion, the standards applied to food additives in feed trials are significantly higher than those applied to pharmaceuticals where, to treat successfully some conditions of illness, certain side effects caused by the treatments can be tolerated. The ADI is an estimate of the amount of a food additive that can be consumed safely over an entire lifetime. ADI levels are set by JECFA after considering the results of various feeding trials. As a general rule, the ADI value is set at one hundredth of the intake, which produces virtually no toxicological effects in long term animal feeding trials (Mitchell, 1990).

2.8 Process Capability

Process capability is the long-term performance level of the process after it has been brought under statistical control. In other words, process capability is the range over which the natural variation of the process occurs as determined by the system of common causes.

Process capability, for a stable manufacturing process, is the capacity of the process to reach a certain level of quality. It can be shown graphically using histograms and process capability charts

2.8.1 Process Capability Index (Cp)

The Process Capability Index (Cp) is expressed as a ratio to the specified value. It is used to quantitatively evaluate the adequacy of the of the process capability – whether the variation in the process is within the limits of the specifications (SLSI, 2006).

Table 2.5: Process capability assessment table

Cp	Evaluation	Assessment
Cp > 1.33	Good	Process capability completely meets specifications.
1.33 >= Cp > 1.0	Acceptable	Process capability does not completely meet specifications; process control should be continued.
1.0 >= Cp	Inadequate	Process capability inadequate; improvements should be made.

(Source: SLSI, 2006)

CHAPTER 03

Methodology

3.1 Define the scope, food safety policy and related objectives

Scope of the food safety management system was defined by identifying the company profile as a entering to the food safety management system study. Food safety policy and related objectives were recorded as a preliminary step to implementation of food safety management system and to identify the commitment of the company for its safe food production.

3.2 Identification of a food safety team

Food safety team was designated to consist of appropriate number of members with specific knowledge and responsibilities that each person involved in the company activities. The team was appointed team leader who had a good knowledge about the factory activities and experienced in implementation of food safety management system.

3.3 Appoint a responsibilities and authorities

Responsibilities and authorities related to each person was defined and communicated within the organization to ensure the effective operation and maintenance of the food safety management system.

3.4 Establishment of effective arrangement for communication, emergency preparedness, management review and training programs

Effective arrangement for communication through out the food chain, emergency preparedness programs, management review meetings at planned intervals and training programs were scheduled according to the organization activities.

3.5 Product description and intended use of carbonated beverages

Product features and attributes were understood and description of the product such as composition, structure, processing, packaging, storage and distribution conditions, and expected shelf life as well as type of raw materials used, ingredients used, and

quantities of ingredients were identified and recorded. Product's intended usages were identified as considering its characteristics and observing catered target market.

3.6 Construction of process flow diagram

Process flow for each product were identified and constructed the flow diagram by covering all the stages from raw materials to end products for evaluate the possible occurrence, increase or introduction of food safety hazards.

Factory layout was identified with potential delay stages. Simultaneously all possible cross-contamination risks that would happen were identified. Then the process flow diagrams were confirmed with the discussion of the food safety team.

3.7 Hazard assessment by identifying significant hazards

All food safety hazards such as biological, chemical and physical hazards that are reasonably expected to occur in relation to the type of product and process were identified and recorded. The identification was based on the preliminary information, experiences, external information and information from the food chain.

A hazard assessment was conducted to determine, for each food safety hazard identified, whether its elimination or reduction to acceptable levels was essential to the production of safe food, and whether its control is needed to enable the defined acceptable levels to be met. Decision tree was used to find out answers for above questions.

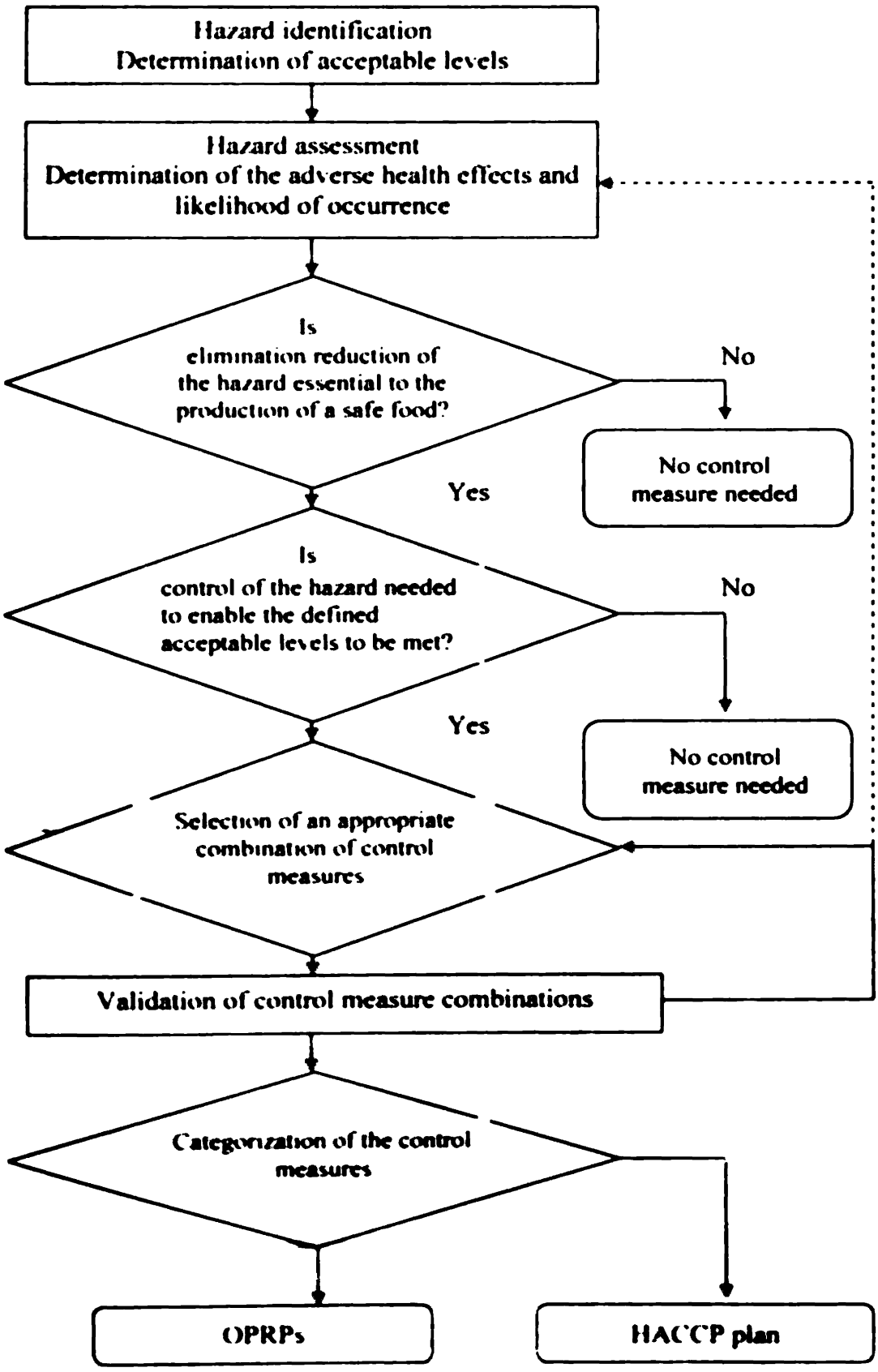

Fig. 3.1: Hazard assessment decision tree (ISO/TS 22004:2005(E))

Each food safety hazard was evaluated according to the possible severity of adverse health effects and the likelihood of their occurrence using risk assessment matrix.

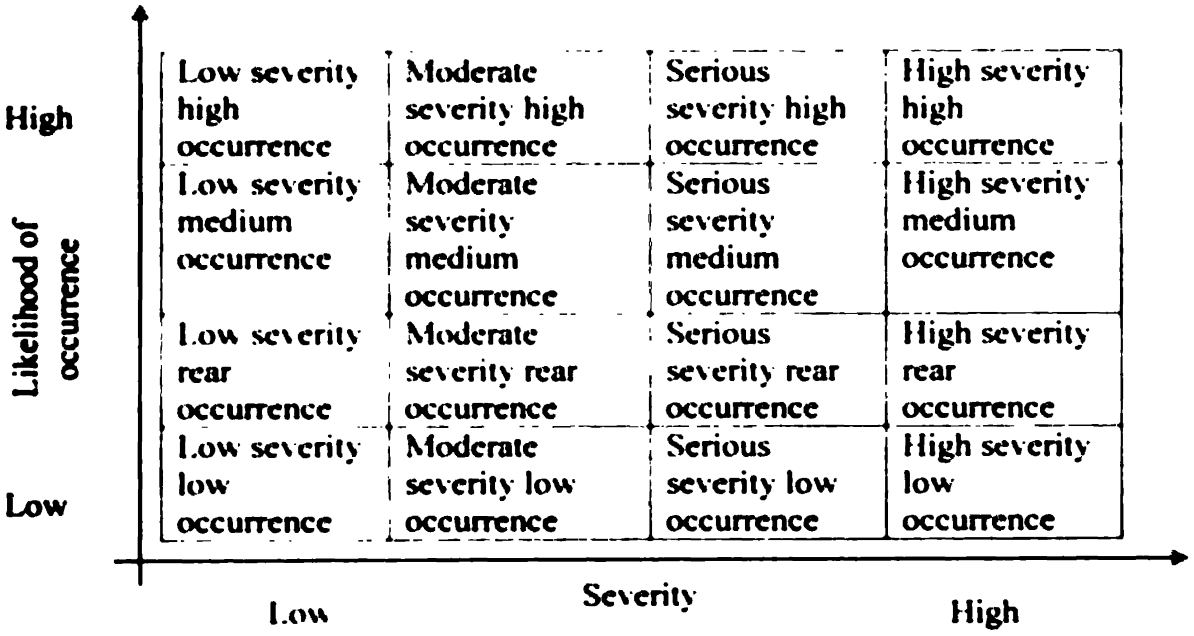

Fig. 3.2: Risk assessment matrix

Criteria for severity

- No or little discomfort
- Diarrhea
- Doctor, hospitalization
- Life threatening (death)

Probability likelihood of occurrence

- Once per year
- Monthly
- Daily
- Constantly

The risk level was differentiated in 5 categories

1	Negligible	- no need to have control measures
2-3	Minor	- low level of control
4-8	Important	- implement require PRPs
9-15	Major	- more stringent OPRPs
16	Critical	- HACCP plan

3.8 Selection and assessment of control measures

Based on the hazard assessment appropriate combination of control measures was selected which is capable of preventing, eliminating or reducing the food safety hazard to defined acceptable levels.

3.9 Development of Prerequisite programs (PRPs)

Prerequisite programs (PRPs) were developed by considering and utilizing appropriate information such as statutory and regulatory requirements, customer requirements, recognized guidelines, Codex principles and codes of practices, and national or international standards.

3.10 Establishment of the Operational Prerequisite programs (OPRPs)

By considering the control measures and the monitoring frequency, determined OPRPs were established.

Food safety hazard(s) to be controlled by the program, control measure(s), monitoring procedures that demonstrate that the OPRPs are implemented, corrective actions to be taken if monitoring shows that the OPRPs are not in control, responsibilities and record(s) of monitoring were included to the Operational Prerequisite program.

3.11 Establishment of the HACCP plan

According to the hazard assessment, determined HACCP plan was established.

Food safety hazard(s) to be controlled at the CCP, control measure(s), critical limit(s), monitoring procedure(s), corrective action(s) to be taken if critical limits are exceeded, responsibilities and record(s) of monitoring were included to the HACCP plan.

3.12 Validation of control measure combinations

CO_2 gas volume, brix and pH value in the cola, mandarin, soda, cream soda and lemonade process were measured by using gas volume tester, refractometer and pH meter. Data were collected within three months. Validation of control measure combinations were done by using process capability analysis to the collected data. Microbiological analysis for raw water was done in once a month.

Methods for microbiological analysis of raw water

Aerobic plate count test (Pour plate method)

Materials: water samples, 1.0 ml pipettes, petri dishes.

Method:

1 ml of the test samples were transferred to the sterilized petri dishes using sterilized pipettes. 15 ml of the plate count medium at 45 ± 0.5 ^{0}C was poured in to each petri dish. (Procedure was repeated with the prepared dilution series). The inoculum with the medium was mixed thoroughly and allowed to solidify placing the petri dishes on a clean horizontal surface. After complete solidification, the dishes were inverted and incubated at 30 ± 1 ^{0}C for 72 ± 3 hours. After the specified period of incubation, colonies were counted using the colony counting equipment (SLS 516: part 1: 1991).

Presumptive coliform test

Materials: water samples, 1.0 ml pipettes, 5 ml of single strength MacConkey broth with inverted Durham tube.

Method:

The sample bottles were inverted several times. The stopper was removed and flame the mouth of the bottle. Volumes of 1.0 ml of the original samples were inoculated in to 5 ml of single strength MacConkey broth with inverted Durham tube. The inoculated tubes were incubated at 36.0 ^{0}C ± 0.5 ^{0}C and examined each tube for the production of acid and gas after 24 to 48 ± 2 hours or earlier.

Acid and gas produced tubes constitute as presumptive coliform positive and the absence of formation of acid and gas constitute a negative test (SLS 614: part 2: 1983).

Confirmation coliform and E.coli test

Materials: peptone water (pre heated to 44 ^{0}C), Kovac's reagent, test tubes, pipettes.

Method:

All the presumptive positive coliform tubes were sub cultured in to tubes of peptone water (pre heated to 44 ^{0}C). Sub cultured tubes were incubated for 6 to 24 hours in a water bath maintain at 44 ± 0.1 ^{0}C. The incubated tubes were immersed in the water at least to the level of broth in the tube. Half of the contents of the peptone culture were transferred to a test tube in aseptic precautions 0.2 ml - 0.3 ml of Kovac's reagent was added to it and mixed gently

The appearance of red colour in the upper layer indicates a positive for confirmed coliform and E.coli. If gets positive for confirmed coliform and E.coli; Most Probable Number (MPN) of coliforms and E.coli were estimated by calculating the MPN of coliforms per 100 ml of sample and MPN of E.coli per 100 ml of sample (SLS 614: part 2: 1983, table in appendix C).

3.13 Verification and improvement of food safety management system

Internal audit plan and food safety plan were developed to complete the verification procedure of food safety management system.

3.14 Documentation of food safety management system

All the records and forms were documented as Pre requisite programs, Operational Pre requisite programs and HACCP plan.

CHAPTER 04

Results and discussion

4.1 Scope, food safety policy and related objectives

4.1.1Scope

The food safety management system was developed to prevent, eliminate or reduce food safety hazards reflected with carbonated beverage process, products and production sites in order to ensure that food is safe at the time of human consumption through out the food chain.

Company profile

Shaa Cola Beverages (Pvt) Limited is one of the subsidiary company of Jaycey group and it was set up in year 2006.

Company engaged in the process of manufacturing range of carbonated beverages including soda, cream soda, cola, mandarin, tamarind, lemonade, etc. which are marketed under the brand name "Shaa".

The company is situated at Millawa, Moragahahena, in Horana town in Kalutara District and the head office of the company is at 11/7, Baddagana, Pitakotte in Colombo district.

All the raw materials required for production of Sogo Bottled Drinking Water such as PET bottles, Lids, Labels, Corrugated boxes are also manufactured by other subsidiary companies of Jaycey Group.

Water required for production of carbonated beverages, is extracted from more than 120 feet deep tube wells as a main raw material Other raw materials are purchased form the approved list of suppliers and packaging materials are purchased from fully owned subsidiaries of JC group of companies.

They incorporate some of the fully automated modern machinery with high technology, such as carbonation, filling and capping machines. There is no any single point in the filling process where humans are directly involved with open product.

Quality Assurance testing of the process is carried out at fully equipped in house laboratory where well qualified personnel are involved.

Marketing, Sales and Distribution are done by Shaa Cola Beverages (Pvt) Ltd and the company use their own studio (jubilant media network) and printing press to advertise & promote their products.

4.1.2 Food safety policy and related objectives

Food safety policy

Shaa cola beverage (pvt) limited is committed to produce safe and superior quality beverages to surpass the customer expectation by continual improvement across our value chain by;

- Developing and implementing a food safety management system towards fulfilling the food safety objectives.
- Ensuring safe and healthy work environment and safe guarding property as per the company requirements.
- Continually training our employees on safe manufacturing practices and vigorously implementing best practices in all areas to protect the health and safety of our employees, customers and consumers.
- Assure the food safety and reliability to all our products.

Food safety objectives

- **Laboratory and Quality Assurance Section**
  - Maintain the microbiological parameters in finished product by maintaining maximum hygienic conditions in production area.
  - Maintain the chemical parameters in finished product by calibrating instruments and correct ingredient weighing.
- **HR Section**
  - Improve the skills and knowledge of employees for safe food production by continuous training in each section.
- **Production**
  - Increase safe food production by 12% quarterly
  - Reduce food wastage incidences by 2% quarterly

- Increase customer satisfaction index (product development, product modification) by 1% quarterly.

4.2 Identification of a food safety team

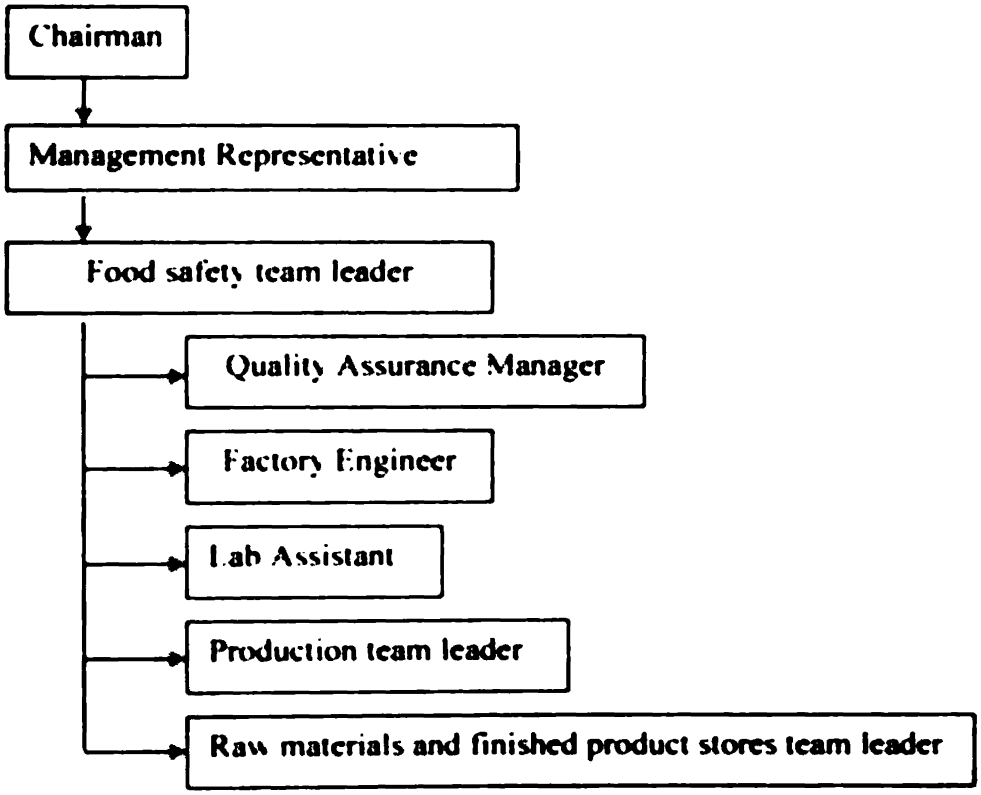

Fig. 4.1: Food safety team

4.3 Appoint a responsibilities and authorities

Chairman

- Overall responsibility of the management in the company

Management Representative

- The food safety management related responsibilities are vested with MR

Food safety team leader – Operational Manager

- Manage a food safety team and organize its work.
- Update the preliminary information and documents specifying the PRPs, OPRPs and the HACCP plan.
- Ensure a relevant training and education of the food safety team members.
- Ensure that food safety management system is established, implemented, maintained and updated.
- Report to the top management on the effectiveness and suitability of the food safety management system.
- Responsible and authority related to monitoring and evaluation of monitoring results.
- Verification results should be recorded and communicated to the food safety team.
- Responsible for control of non conformities.

Quality Assurance Manager

- Identify the quality assurance points of the production and other supportive activities and implement documented procedures.
- Identify the resources required to introduce the above quality assurance measures and communicate with food safety team leader.
- Maintaining of environmental hygiene and personal hygiene and training of workers.
- Carry out R&D experiments to upgrade the products and introduce new products.
- The quality related responsibilities given in the interface matrix are also vested with QAM.

Factory Engineer

- Responsible for optimization of machines to achieve the production target.
- Servicing of the machines according to the schedule plan
- Training of machine operators.
- Responsible for maintaining of tool box and spare parts of the machines and other equipments.

- Minimize machines break downs.
- Changing of the machine mould (For changing of production category according to the schedule production plan).

Lab Assistant

- Responsible for minimum contamination through out the food chain.
- Carry out chemical and microbiology tests according to the schedule plan.
- Take immediate action if having any food safety problem.
- Responsible for changing UV bulb and filters.
- Report to the food safety team leader on the effectiveness of microbiological test results.

Production team leader - Supervisor

- Implementation of monthly production plan given by the food safety team leader to meet the monthly set target and company food safety objectives.
- Responsible for the fulfilling of daily production target by producing safe products.
- Arrange the production line so that minimize unnecessary delays of production flow, and educate the workers of the same (Time management and work study)
- Identify required resource for the production flow and communicate it with food safety team leader.
- Responsible of maintaining personal and environmental hygiene.
- Maintaining good work practice and discipline in the production flow.

Raw materials and finished product stores team leader – Store Keeper

- Implementation of monthly raw material receiving plan and finished product dispatching plan given by the food safety team leader to meet the monthly set target and company food safety objectives.
- Arrange the stores as a "FIFO" method so that minimize unnecessary delays of raw materials and finished product supplements.
- Identify required raw materials or any problems related to stores and communicate it with food safety team leader

4.4 Establishment of effective arrangement for communication, emergency preparedness, management review and training programs

4.4.1 Communication

External communication

Top management of Shaa Cola beverages (Pvt) Ltd ensures that appropriate communication channels are established to communicate with suppliers, contractors, customers/consumers, statutory and regulatory authorities and other organizations. The following communication channels are used for the purpose.

- Advertisements in Max television and Max radio
- News paper, poster, sticker advertisements
- Label in the product

Internal communication

Top management of Shaa Cola beverages (Pvt) Ltd ensures that appropriate communication channels are established within the company. The following communication channels are used for the purpose.

- Management - led communication in work areas
- Team briefings and other meetings
- Notice boards
- Audio visual and electronic media

4.4.2 Emergency preparedness

Top management of the company should be prepare that response to potential emergency situations and accidents that can impact on food safety include incidents such as fire, flooding, bio-terrorism and sabotage, emergency failure, vehicle accidents, contamination of the environment, various type of whether related events or the impact of the pandemic by; emergency preparedness planning relevant to food safety policy, appointing incident planning coordinator, forming incident planning committee with representatives from all the major parts of the organization, train the staff and carry out exercises of the plan.

Table 4.1: Emergency preparedness plan

Emergency situations	Action taken	Responsibility	Incident planning coordinator
1. Fire	Deploy available fire-fighting facilities. Inform to factory engineer. Isolate products likely to be contaminated by fire extinguisher chemicals.	Every person in the company	Factory engineer
2. Power cut	Inform to factory engineer. Start generators to meet key power requirements.	Every person in the company	Factory engineer
3. Water pressure drop or stoppage	Inform to factory engineer. Limit water use to vital plant functions only.	Every person in the company	Factory engineer
4. Emergency failure	Inform to operational manager. Take necessary action.	Every person in the company	Operational manager
5. Workers accidents	Inform to medical officer. Immediately supply treatments.	Every person in the company	Medical officer
6. Vehicle accidents	Inform to medical officer. Damage person immediately transport to the hospital	Any person	Medical officer

4.4.3 Management review

Management representative (MR) shall organize the management reviews at least once in three months. If need arises due to Non-implementation of the recommended actions agreed during the previous Management Review Meeting, accumulation of a number of customer complaints, accumulation of a number of non-conformities the MR shall convene an extra ordinary Management Review Meeting

MR shall inform the meeting to the committee members using the minutes of the previous meeting.

The committee shall discuss the review inputs such as follow-up actions from previous management reviews, analysis of results of verification activities, changing circumstances that can affect food safety, emergency situations, customer feedback, external audits or inspections. Review output should be included decisions and actions related to assurance of food safety, improvement of the effectiveness of the food safety management system, resource needs and revisions of the organization's food safety policy and related objectives.

These meetings were minute by indicating recommendations clearly with responsibilities and time frames for implementation and circulate the minute among the participants within one week after the meeting. All the relevant officers shall ensure that recommended actions are implemented by the identified target dates. All records pertaining to the management review meetings shall be maintained by the MR.

4.4.4 Training programs

Training programs provide a procedure to maintain & improve the knowledge of the employees in the company to consistently meet and exceed customer requirements. The overall responsibility of training the staff is vested with management representative (MR). MR identifies the training needs at least once a year using information from employee performance evaluation report. The training was carried out as; induction and orientation training for new recruits, on the job training to improve knowledge and operational skills for safe food production by ensuring personal responsibilities.

The detail of the training received is summarized and evaluation of training during the year is carried out by operational manager and MR.

4.5 Product description and intended use of carbonated beverages

Product is a carbonated beverage that will be consumed mainly for the thirst quenching property by the general population including children and elders.

Product name: Shaa cola

Ingredients: Carbonated water

Sugar

Caramel colour

Cola part B (Artificial flavour)

Sodium benzoate - E 211 (Preservative)

Ortho phosphoric acid E 338 (Acidualant)

Packaging materials:

PET bottles: Colourless

Bottle cap (with neck cap): Red in colour

Chemical characteristics:

Gas volume range: 4.0 - 5.0

Brix range: 9.5 - 10.5

pH range: 2.0 - 3.0

Benzoic acid requirement: 160 mg/kg

Caffeine content: < 150 mg/kg

Product name: Shaa cream soda

Ingredients: Carbonated water

Sugar

Sunset yellow - E 110 (Colour)

Cream soda flavour (Artificial flavour)

Sodium benzoate - E 211 (Preservative)

Citric acid - E 330 (Acidualant)

Xanthen gum - E 415 (Stabilizer)

Packaging materials:

PET bottles: Colourless

Bottle cap (with neck cap): violet in colour

Chemical characteristics:

Gas volume range: 3.0 - 4.0

Brix range: 12.5 - 13.5

pH range: 3.0 - 4.0

Benzoic acid requirement: 160 mg/kg

Product name: <u>Shaa soda</u>

Ingredients: Carbonated water

Sodium bicarbonate

Packaging materials:

PET bottles: Colourless

Bottle cap (with neck cap): Ash in colour

Chemical characteristics:

Gas volume range: 4.0 – 4.5

Brix range: -

pH range: 4.0 – 4.5

Sodium bicarbonate: < 560 mg/kg

Product name: <u>Shaa mandarin</u>

Ingredients: Carbonated water

Sugar

Sunset yellow - E 110 (Colour)

Dalandan flavour - nature identical (Artificial flavour)

Sodium benzoate - E 211 (Preservative)

Citric acid – E 330 (Acidualant)

Xanthen gum – E 415

Packaging materials:

PET bottles: Colourless

Bottle cap (with neck cap): Orange in colour

Chemical characteristics:

Gas volume range: 2.5 – 3.5

Brix range: 12.0 – 13.0

pH range: 2.5 – 3.5

Benzoic acid requirement: 160 mg/kg

Product name: <u>**Shaa tamarind**</u>

Ingredients: Carbonated water

Sugar

Caramel colour

Tamarind flavour (Artificial flavour)

Sodium benzoate - E 211 (Preservative)

Sodium chloride

Citric acid - E 330 (Acidualant)

Sodium dehydrogen citrate – E 331 (Acidity regulator)

Packaging materials:

PET bottles: Colourless

Bottle cap (with neck cap): Brown in colour

Chemical characteristics:

Gas volume range: 3.0 - 3.5

Brix range: 12.5 – 13.0

pH range: 2.5 - 3.5

Benzoic acid requirement: 160 mg/kg

Product name: <u>**Shaa lemonade**</u>

Ingredients: Carbonated water

Sugar

Natural lemon flavour

Sodium benzoate - E 211 (Preservative)

Citric acid – E 330 (Acidualant)

Sodium dehydrogen citrate – E 331 (Acidity regulator)

Packaging materials:

PET bottles: Light green

Bottle cap (with neck cap): Dark green in colour

Chemical characteristics:

Gas volume range: 3.0 - 4.0

Brix range: 9.5 - 10.5

pH range: 2.5 - 3.5

Benzoic acid requirement: 160 mg/kg

• Below mention characteristics are same for all above beverage products.

Microbiological specifications:

Standard plate counts, per ml, max.	<100
Coliforms, per ml	absent
Yeast and moulds count per ml	absent

Heavy metal limits:

Arsenic, mg/kg, max.	0.2
Copper, mg/kg, max.	2
Lead, mg/kg, max.	0.2

Packaging size/ Volume: 350 ml, 500 ml, 1000ml

Shelf life: 6 months from manufacture date under ambient temperature or refrigerated conditions and away from sun light.

Label information: Product name, Brand name, Batch code, Date of manufacturing, Date of expiry, Retail price, Barcode, Storage condition, Contact address printed on the bottle.

Intended consumer: Consumers at all ages

Intended use: Ready to drink

4.6 Construction of process flow diagram

Process flow diagram for Shaa soda

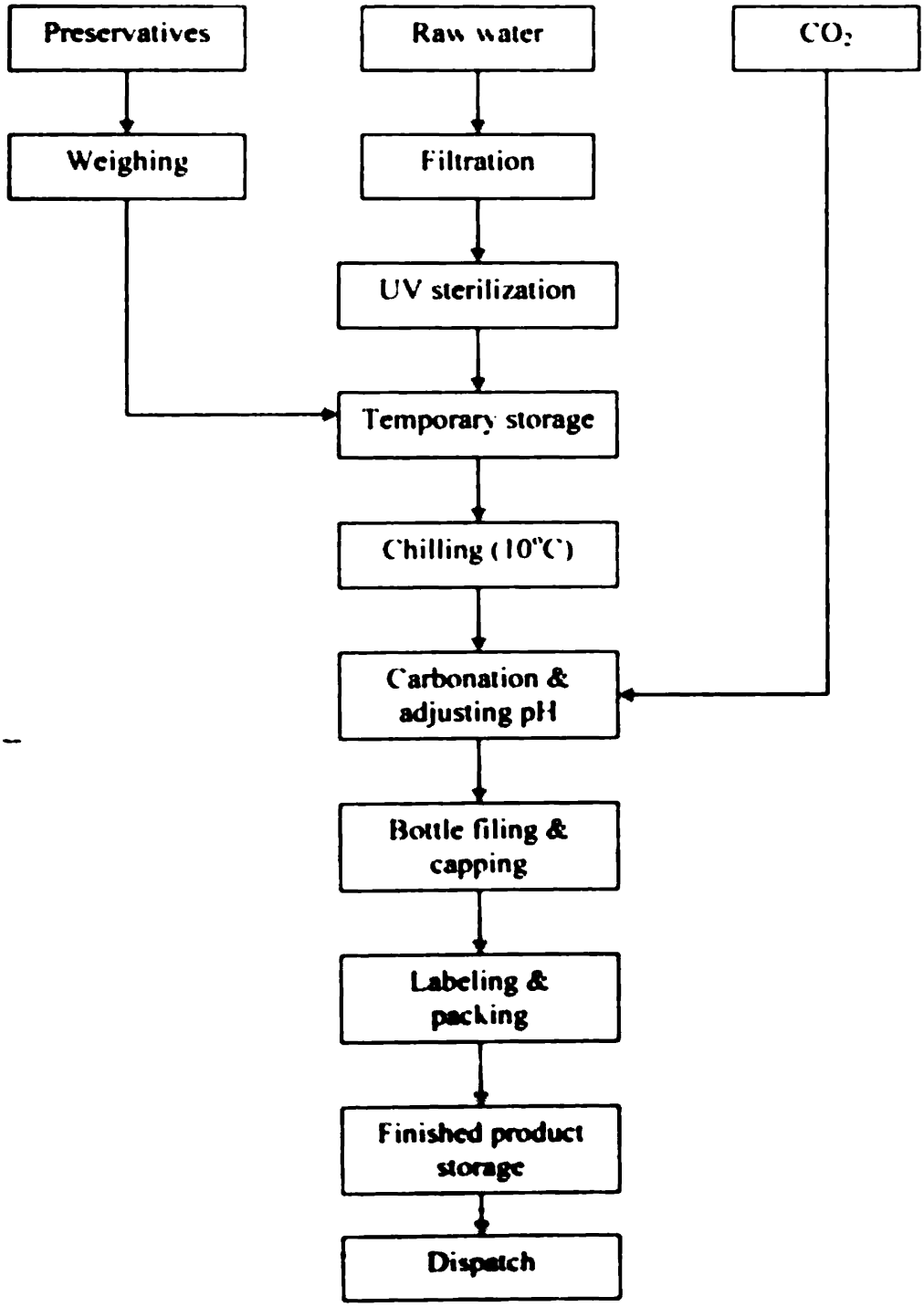

Fig. 4.2: Process flow diagram for Shaa soda

Process flow diagram for Shaa cola, cream soda, mandarin, tamarind and lemonade

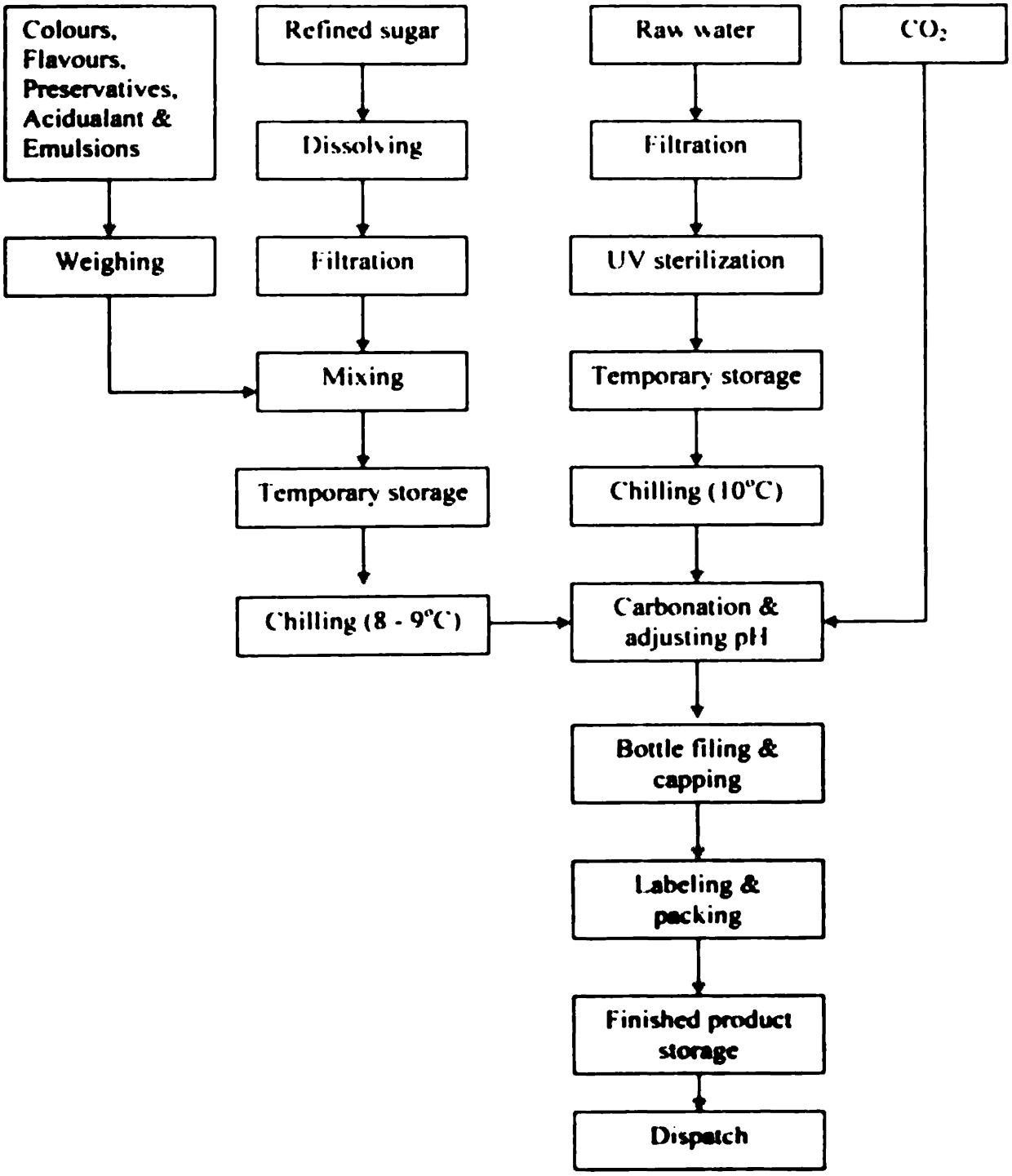

Fig. 4.3: Process flow diagram for Shaa cola, cream soda, mandarin, tamarind and lemonade

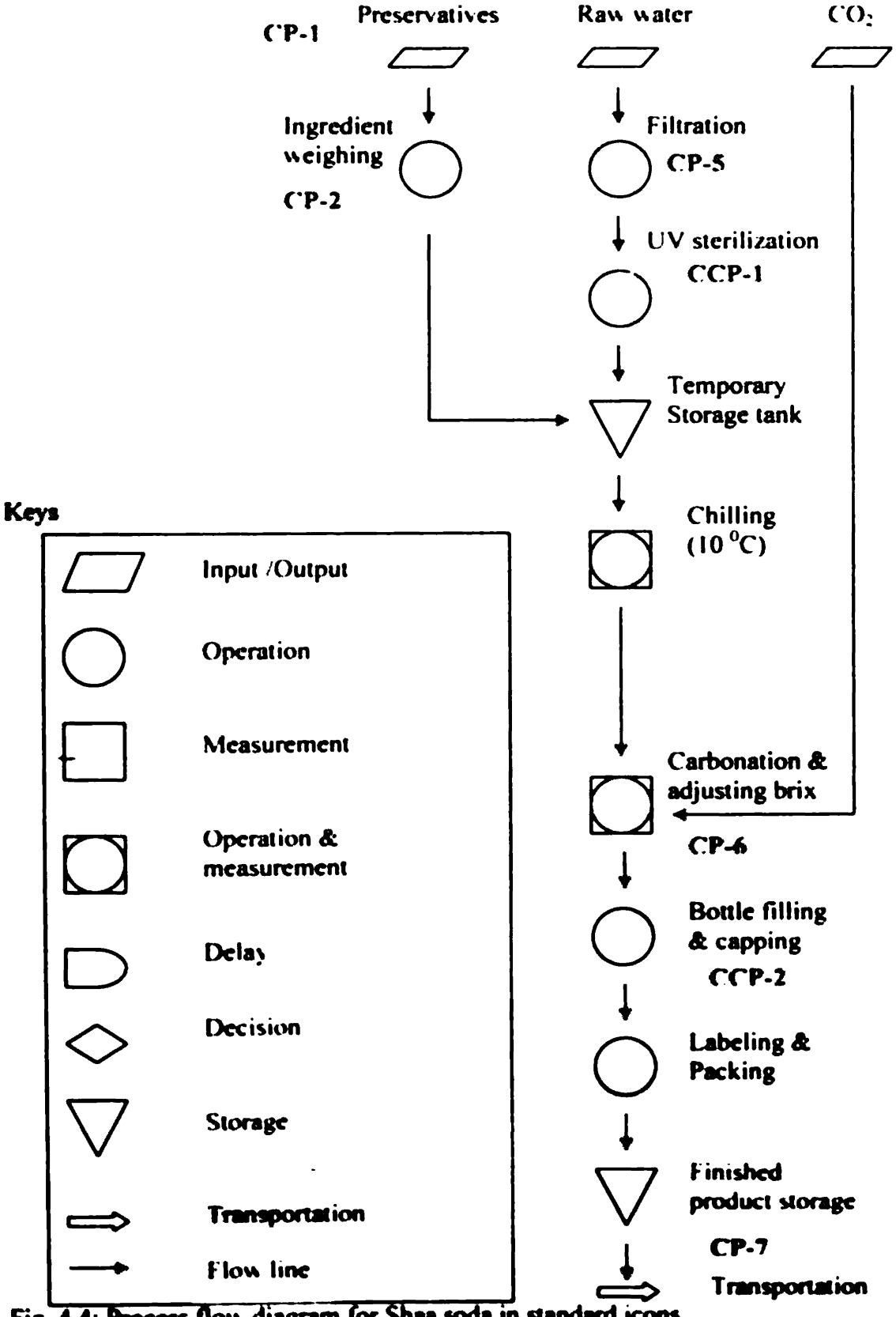

Fig. 4.4: Process flow diagram for Shaa soda in standard icons

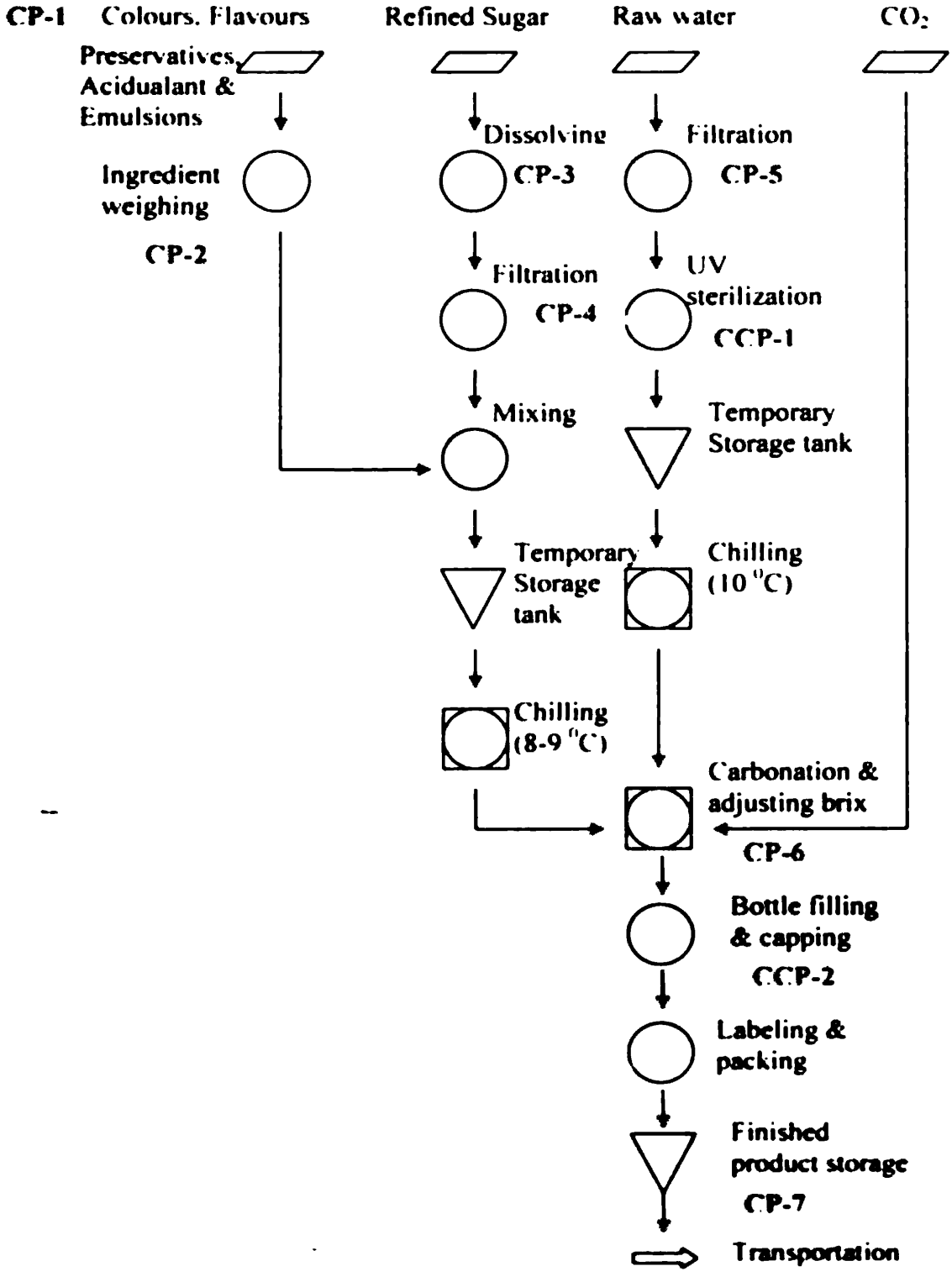

Fig. 4.5: Process flow diagram for Shaa cola, cream soda, mandarin, tamarind and lemonade in standard icons

Factory layout

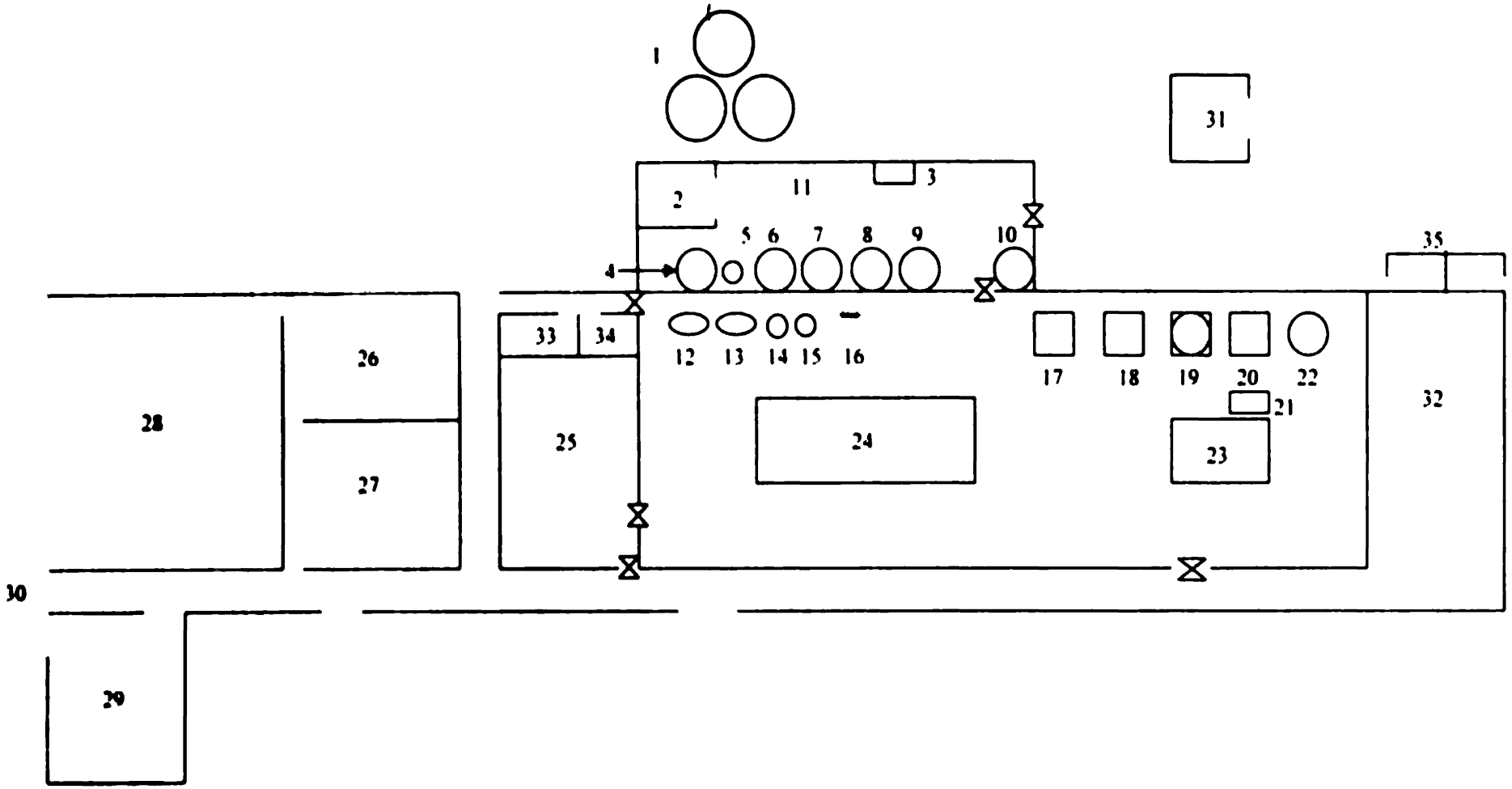

Fig 4.6: Factory layout

Locations indicated by numbers:

1. Raw water storage tank
2. Raw material storage area
   Sugar, acidualant and preservatives (bags)
   Colours, flavours, and emulsion (cans)
3. Electric balance
4. Sugar mixing tank
5. Sugar filtration (0 5 micron filters)
6. Syrup storage tank-1
7. Syrup storage tank-2
8. Syrup storage tank-3
9. Syrup storage tank-4
10. Water storage tank
11. Syrup room
12. Water filtration (sand filter)
13. Water filtration (Active carbon filter)
14. Water filtration (0 5 micron filters)
15. Water filtration (0 2 micron filters)
16. UV sterilizer
17. Water chiller (10°C)
18. Continues water chilling tank (10°C)
19. Carbonation plant
20. Syrup chiller (8°C – 9°C)
21. Continues syrup chilling tank
22. Treated water storage tank
23. Filling and Capping machine
24. Labeling & packing area
25. Raw material storage area
    (PET bottles and lids)
    (Labels and corrugated boxes)
26. Laboratory
27. Office
28. Sogo drinking water bottling section
29. Finished product storage area
30. Factory entrance
31. Canteen
32. Maintenance equipment storage area
33. Changing room – male
34. Changing room – female
35. Toilets

Production layout

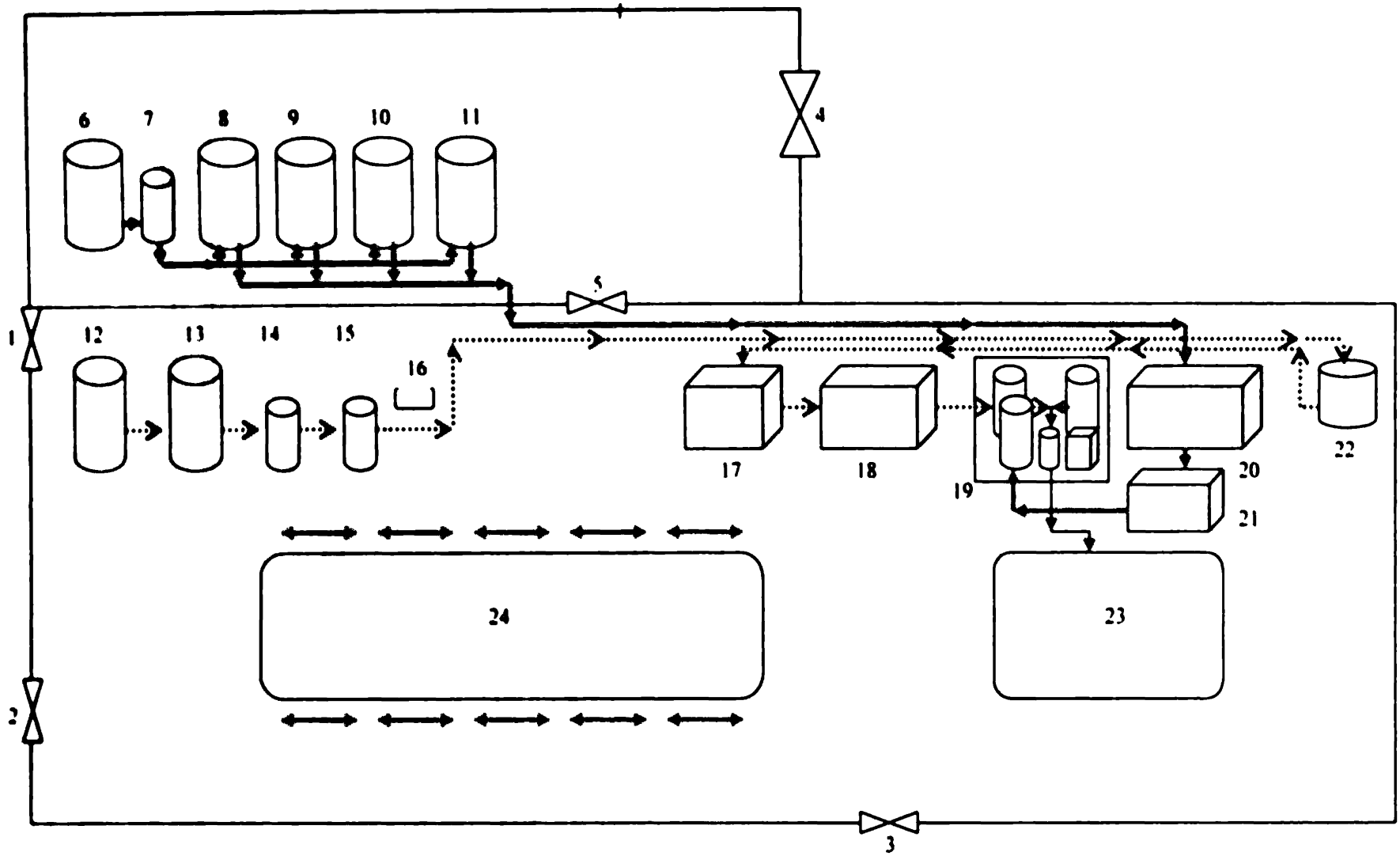

Fig. 4.7: Production layout

Locations indicated by numbers:

1. Workers entrance
2. Raw material entrance (PET bottles, lids, cartons)
3. Finished product exit
4. Raw material entrance (sugar and other ingredients)
5. Syrup room entrance
6. Sugar mixing tank
7. Sugar filtration (0.5 micron filters)
8. Syrup storage tank-1
9. Syrup storage tank-2
10. Syrup storage tank-3
11. Syrup storage tank-4
12. Water filtration (sand filter)
13. Water filtration (Active carbon filter)
14. Water filtration (0.5 micron filters)
15. Water filtration (0.2 micron filters)
16. UV sterilizer
17. Water chiller (10^{0}C)
18. Continues water chilling tank (10^{0}C)
19. Carbonation plant
20. Syrup chiller (8^{0}C - 9^{0}C)
21. Continues syrup chilling tank
22. Treated water storage tank
23. Filling and Capping machine
24. Labeling & packing area


Concentrated syrup flow (brix 60^{0} -65^{0})


Water flow


Diluted syrup flow (brix 10^{0} -15^{0})

Workers flow

4.7 Hazard assessment by identifying significant hazards

Table 4.2: Hazard assessment by identifying significant hazards

Process step	Significant hazards Biological: B Chemical: C Physical: P	Is elimination/reduction of the hazard essential to the production of a safe food?	Is control of the hazard needed to enable the defined acceptable levels to be met?	Control measure
1. Raw material receiving				
• Sugar	B: Pathogenic bacteria, Yeasts, Moulds	Yes	Yes	OPRP/HACCP
	C: Sulphate ash, Cleaning chemicals, Antibiotics, Pesticides	Yes	Yes	OPRP/HACCP
	P: Water insoluble matters, Dead bodies (pest/insects), Dust particles, Metal particles	Yes	Yes	OPRP/HACCP
• CO_2	B: Not applicable	No	-	No need
	C: presence of toxic gasses	Yes	Yes	OPRP/HACCP
	P: Foreign matters	Yes	Yes	OPRP/HACCP
• Flavours, Emulsions, Acids, colours &	B: Air born contaminants	Yes	Yes	OPRP/HACCP
	C: Toxic substances, Oxidants, Antibiotics	Yes	Yes	OPRP/HACCP

preservatives • PET bottles & lids	P: Foreign matters	Yes	Yes	OPRP/HACCP
	B: Contamination with vegetative pathogens	Yes	Yes	OPRP/HACCP
	C: Toxic chemicals	Yes	Yes	OPRP HACCP
	P: Foreign matters (dust/plastic particles)	Yes	Yes	OPRP HACCP
2 Raw water filtration	B. Remaining Algae spores	Yes	Yes	OPRP HACCP
	C: Remaining organic matters, Cleaning chemicals	Yes	Yes	OPRP HACCP
	P. Remaining suspended particles, Impurities	Yes	Yes	OPRP HACCP
3 Water UV sterilization	B: Proliferation or survival of vegetative pathogens	Yes	Yes	OPRP/HACCP
	C: Not applicable	No	-	No need
	P: Not applicable	No	-	No need
4 Water chilling	B: Survival of pathogenic bacteria	Yes	Yes	OPRP/HACCP
	C: Cleaning chemical residues	Yes	Yes	OPRP/HACCP
	P: Contamination by gasket materials	Yes	Yes	OPRP/HACCP
5 Sugar dissolving	B: Survival of pathogenic bacteria or yeasts	Yes	Yes	OPRP/HACCP
	C: Formation of acid floc, Cleaning chemical residues	Yes	Yes	OPRP/HACCP
	P: Drop of foreign matters in to the tank, contamination of gasket materials	Yes	Yes	OPRP/HACCP

6. Sugar filtration	B: Remaining yeasts	Yes	Yes	OPRP/HACCP
	C: Remaining acid floc	Yes	Yes	OPRP/HACCP
	P: Remaining un wanted particles & other turbidity components	Yes	Yes	OPRP/HACCP
7. Ingredient weighing	B: Contamination by person	Yes	Yes	OPRP/HACCP
	C: Measuring of excess amount of food additives	Yes	Yes	OPRP HACCP
	P: Drop of foreign matters	Yes	Yes	OPRP HACCP
8 Mixing ingredients with sugar solution	B. Contamination by person	Yes	Yes	OPRP HACCP
	C Cleaning chemical residues	Yes	Yes	OPRP HACCP
	P. Drop of foreign matters	Yes	Yes	OPRP/HACCP
9. Syrup chilling	B: Survival of pathogenic bacteria	Yes	Yes	OPRP/HACCP
	C. Cleaning chemical residues	Yes	Yes	OPRP/HACCP
	P: Contamination by gasket materials	Yes	Yes	OPRP/HACCP
10 Carbonation & adjusting brix	B: Not applicable	No	-	No need
	C: Excess carbonation, excess amount of syrup	Yes	Yes	OPRP/HACCP
	P: Contamination by gasket materials	Yes	Yes	OPRP/HACCP
11. filling & capping	B: Presence of pathogen organisms in filling pipes/bottles/lids Contamination by pathogen organisms due to improper bottle sealing	Yes	Yes	OPRP/HACCP
	C: Cleaning chemical residues	Yes	Yes	OPRP/HACCP

	P: Contamination by metal particles in the filling machine Contamination by foreign matters in bottles/lids	Yes	Yes	OPRP/HACCP
12.Storage and dispatch of bottles	B: Post contamination of pathogen organisms	Yes	Yes	OPRP/HACCP
	C: Not applicable	No	-	No need
	P: Post contamination of foreign matters	Yes	Yes	OPRP/HACCP

4.8 Food safety hazard evaluation by categorizing control measures

Table 4.3: Food safety hazard evaluation by categorizing control measures

Process step	Type of hazard	Risk level	Categorization of control measure
1. Raw material receiving			
• Sugar	Biological	Major	OPRP/RRI & PRP/SA
	Chemical	Major	OPRP/RRI & PRP/SA
	Physical	Major	OPRP/RRI & PRP/SA
• CO_2	Biological	-	-
	Chemical	Major	OPRP/RRI & PRP/SA
	Physical	Major	OPRP/RRI & PRP/SA
• Flavours, Emulsions, Acids, colours & preservatives	Biological	Major	OPRP/RRI & PRP/SA
	Chemical	Major	OPRP/RRI & PRP/SA
	Physical	Major	OPRP/RRI & PRP/SA
• PET bottles & lids	Biological	Major	OPRP/RRI & PRP/SA
	Chemical	Major	OPRP/RRI & PRP/SA
	Physical	Major	OPRP/RRI & PRP/SA
2. Raw water filtration	Biological	Major	OPRP/FPM
	Chemical	Major	OPRP/FPM
	Physical	Major	OPRP/FPM
3. Water UV sterilization	Biological	Critical	HACCP plan
	Chemical	-	-
	Physical	-	-
4. Water chilling	Biological	Major	OPRP/CPM
	Chemical	Important	PRP/CS
	Physical	Important	PRP/CS
5. Sugar dissolving	Biological	Major	OPRP/SRM
	Chemical	Major	OPRP/SRM
	Physical	Important	PRP/CS
6. Sugar filtration	Biological	Major	OPRP/FPM
	Chemical	Major	OPRP/FPM
	Physical	Major	OPRP/FPM

7. Ingredient weighing	Biological	Important	PRP PH
	Chemical	Major	OPRP/SRM & PRP C
	Physical	Important	PRP/PH
8. Mixing ingredients with sugar solution	Biological	Important	PRP/PH
	Chemical	Important	PRP/CS
	Physical	Important	PRP/PH
9. Syrup chilling	Biological	Major	OPRP/CPM
	Chemical	Important	PRP/CS
	Physical	Important	PRP/CS
10. Carbonation & adjusting brix	Biological	-	-
	Chemical	Major	OPRP/CPM
	Physical	Important	PRP/CS
11. filling & capping	Biological	Critical	HACCP plan
	Chemical	Important	PRP/CS
	Physical	Major	OPRP/SRM
12.storage and dispatch of bottles	Biological	Major	OPRP/FPI
	Chemical	-	-
	Physical	Major	OPRP/FPI

4.9 Development of Prerequisite programs (PRPs)

By studying the entire factory, production flow, internal and external environment, prerequisite programs (PRPs) were developed.

Table 4.4: Prerequisite programs (PRPs)

Prerequisite program		Reference
Calibration (C)	PRP 1	Appendix A
Cleaning and Sanitizing (CS)	PRP 2	Appendix B
Personal Hygiene (PH)	PRP 3	Appendix C
Pest Control (PC)	PRP 4	Appendix D
Supplier Assessment (SA)	PRP 5	Appendix E
Waste & Sewage Disposal (WSD)	PRP 6	Appendix F
Water, Air and Energy supply (WAE)	PRP 7	Appendix G

4.10 Establishment of the Operational Prerequisite programs (OPRPs)

By considering identified control points (raw material receiving, ingredient weighing, filtration, chilling, carbonation, finished product inspection), Operational Prerequisite programs (OPRPs) were established.

Table 4.5: Operational Prerequisite programs (OPRPs)

Process step	OPRP program	Reference
Raw material Receiving CP-1	Raw material Receiving and Inspection (RRI) OPRP 1	Appendix H
Ingredient weighing CP-2	Syrup Room Management (SRM) OPRP 2	Appendix I
Sugar dissolving CP-3	Syrup Room Management (SRM) OPRP 2	Appendix I
Sugar filtration CP-4	Filtration Process Management (FPM) OPRP 3	Appendix J
Water filtration CP-5	Filtration Process Management (FPM) OPRP 3	Appendix J
Carbonation CP-6	Carbonation Process Management (CPM) OPRP 4	Appendix K
Storage and dispatch of bottles CP-7	Finished Product Inspection (FPI) OPRP 5	Appendix L

4.11 Establishment of the HACCP plan

Table 4.6: HACCP plan

Process step	Identified Hazard	Control limit	Monitoring procedure	Corrective action	HACCP Records	Verification Procedure	Responsibility
Raw water sterilization CCP-1	Biological	Maintain the. • Aerobic plate count - $1.0*10^4$ per ml • Total coliform count (mpN) - 10per100ml • E-coli count none in 100ml	What • Aerobic plate count • Total coliform count • E-coli count How Microchem laboratory Who Lab assistant Frequency Once a week	o Inform to the maintenance department and maintain wave length at 254 nm or replace the UV bulb after finishing recommended working hours (9000hrs).	o Working hours of UV bulb - log sheet o Changing of UV bulb - log sheet o Maintenance records	o Lab assistant collects the records and reported to the factory engineer	Factory engineer

Process step	Identified Hazard	Control limit	Monitoring procedure	Corrective action	HACCP Records	Verification Procedure	Responsibility
Bottle capping CCP-2	Biological	Maintain the capping strength at least 10 bar	What Capping strength How Measuring capping strength Who Production team leader Frequency Once a hour	o Inform to the machine operator and maintain the capping strength	o machine maintenance records	o machine operator inform to the factory engineer	Factory engineer

4.12 Validation of control measure combinations

Prior to implementation of control measures included in OPRPs and HACCP plan, validation was done to determine that control measures were scientifically and technically sound. Information needed to validate was collected from in-house observations and measurements, scientific studies, expert advisers and evaluations.

For OPRPs validation; brix, CO_2 gas volume, and pH value of each Shaa products were measured and capability of control measures were evaluated by using process capability analysis. HACCP plan validation was done by information gathered from third part laboratory test reports, in-house observations and measurements and scientific studies.

Validation of control measure combinations using process capability analysis

Shaa cola

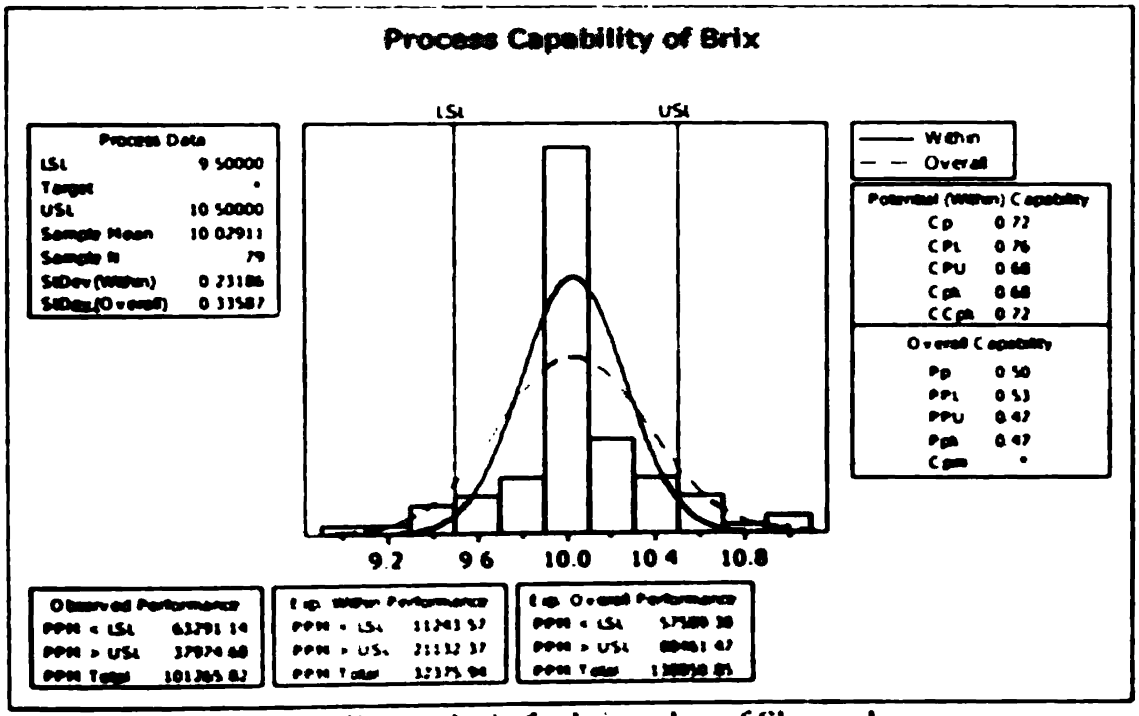

Fig. 4.8: Process capability analysis for brix value of Shaa cola

Interpretation:

Cp = 0.72

1.0 >= Cp

Process capability is inadequate; improvements should be made

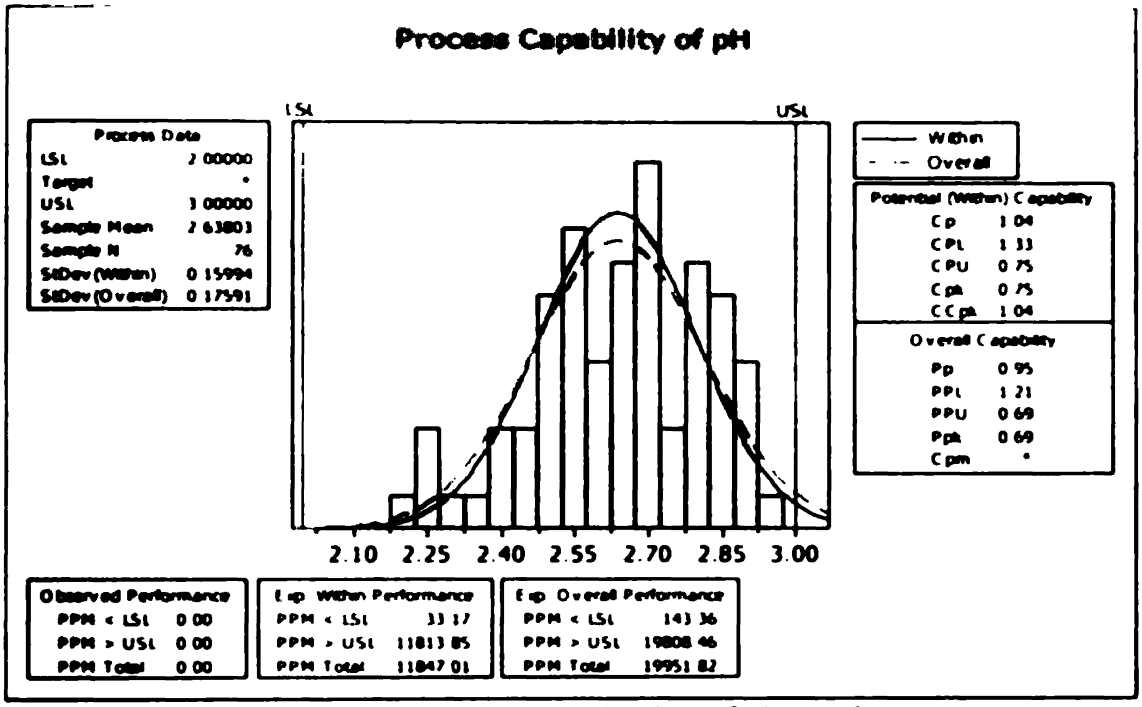

Fig. 4.9: Process capability analysis for pH value of Shaa cola

Interpretation:

Cp = 1.04

1.33 >= Cp > 1.0

Process is acceptable but process capability does not completely meet specifications; process control should be continued.

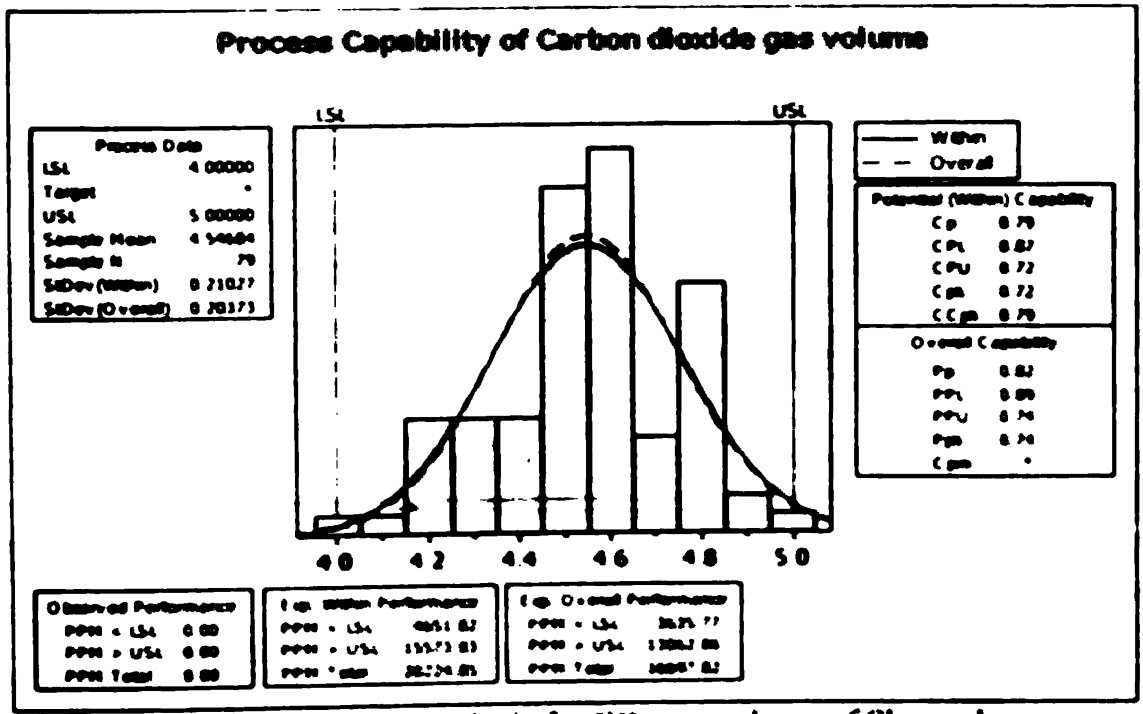

Fig. 4.10: Process capability analysis for CO_2 gas volume of Shaa cola

Interpretation:

Cp 0.79

1.0 > Cp

Process capability is inadequate; improvements should be made.

According to the process capability analysis for pH value, process is acceptable. Cp values for brix and CO_2 gas volume also near to 1.0. Therefore process becomes acceptable. But process capability does not completely meet specifications; process control should be continued.

Shaa mandarin

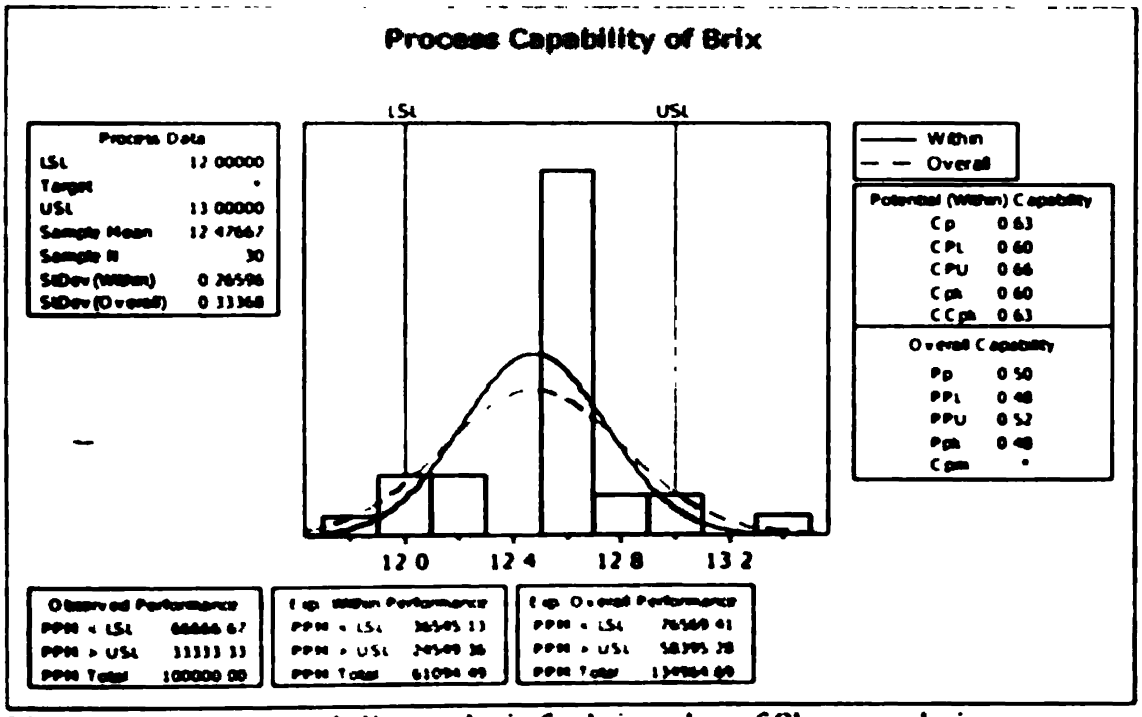

Fig. 4.11: Process capability analysis for brix value of Shaa mandarin

Interpretation:

Cp = 0.63

1.0 > Cp

Process capability is inadequate; improvements should be made.

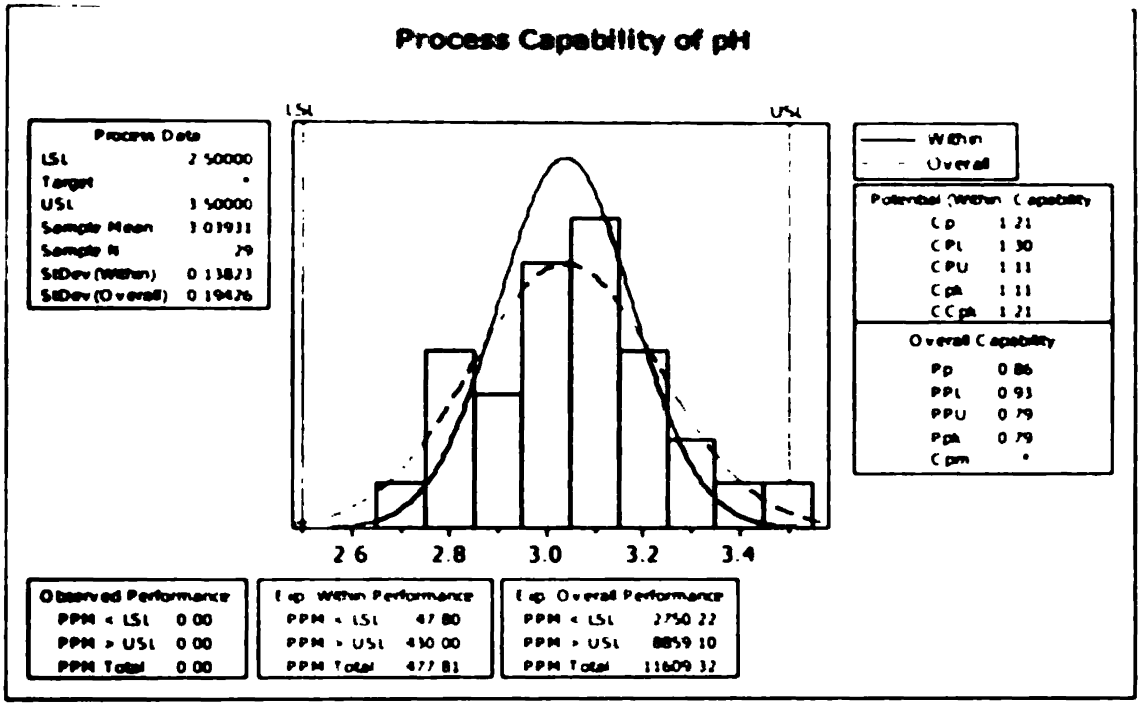

Fig. 4.12: Process capability analysis for pH value of Shaa mandarin

Interpretation:

Cp = 1.21

1.33 > Cp > 1.0

Process is acceptable but process capability does not completely meet specifications; process control should be continued.

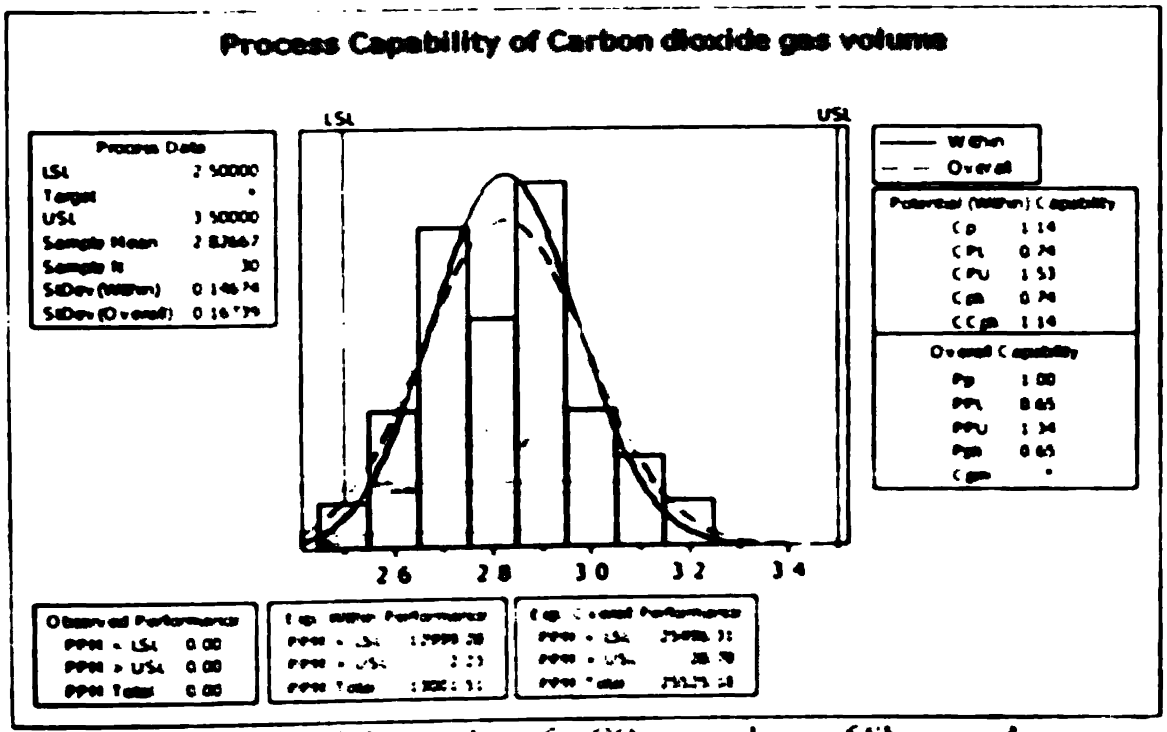

Fig. 4.13: Process capability analysis for CO_2 gas volume of Shaa mandarin

Interpretation:

Cp 1.14

1.33 >= Cp > 1.0

Process is acceptable but process capability does not completely meet specifications; process control should be continued.

According to the process capability analysis for pH value and CO_2 gas volume, process is acceptable. Cp values for brix also near to 1.0. Therefore process becomes acceptable. But process capability does not completely meet specifications; process control should be continued.

Shaa soda

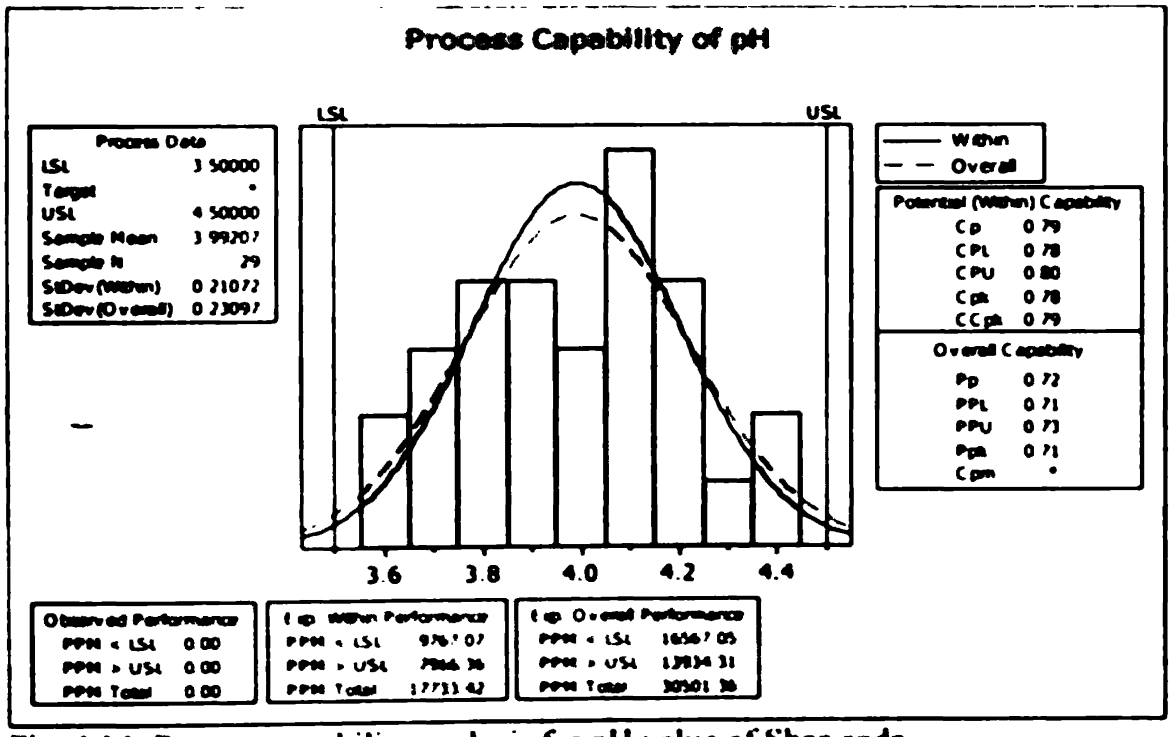

Fig. 4.14: Process capability analysis for pH value of Shaa soda

Interpretation:

Cp = 0.79

1.0 >= Cp

Process capability is inadequate, improvements should be made

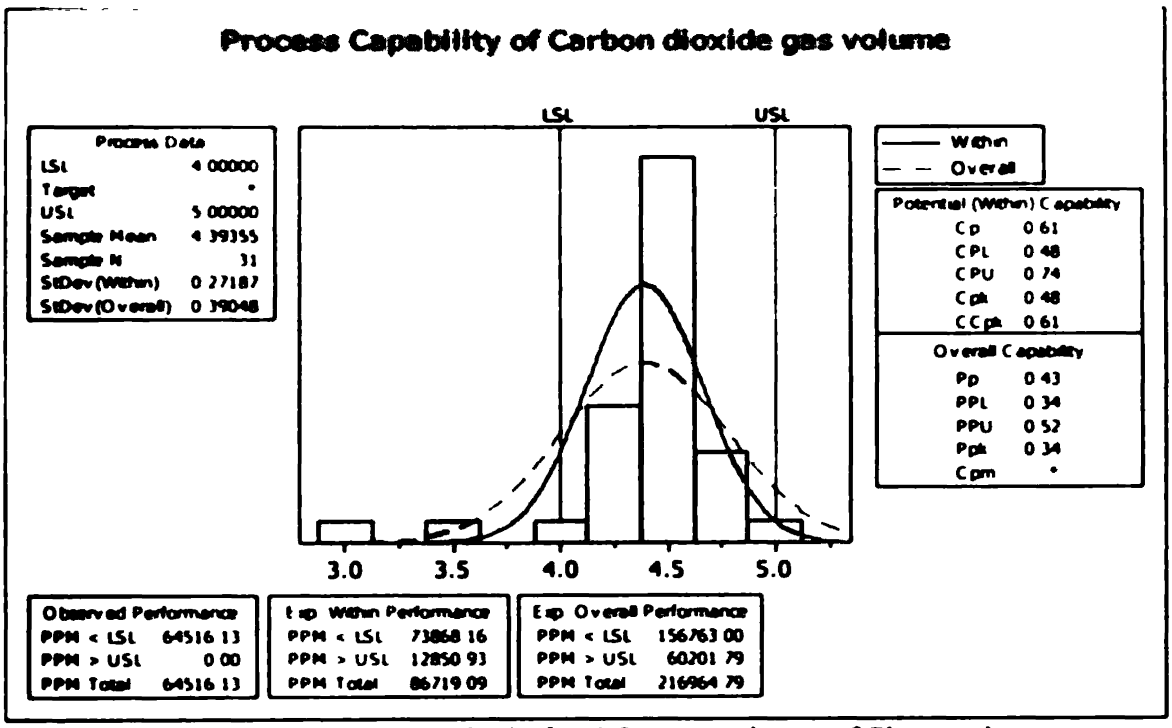

Fig. 4.15: Process capability analysis for CO_2 gas volume of Shaa soda

Interpretation:

Cp = 0.61

1.0 >= Cp

Process capability is inadequate; improvements should be made.

Shaa soda process capability is inadequate for both pH value and CO_2 gas volume. Therefore improvements should be made for soda production process.

Shaa cream soda

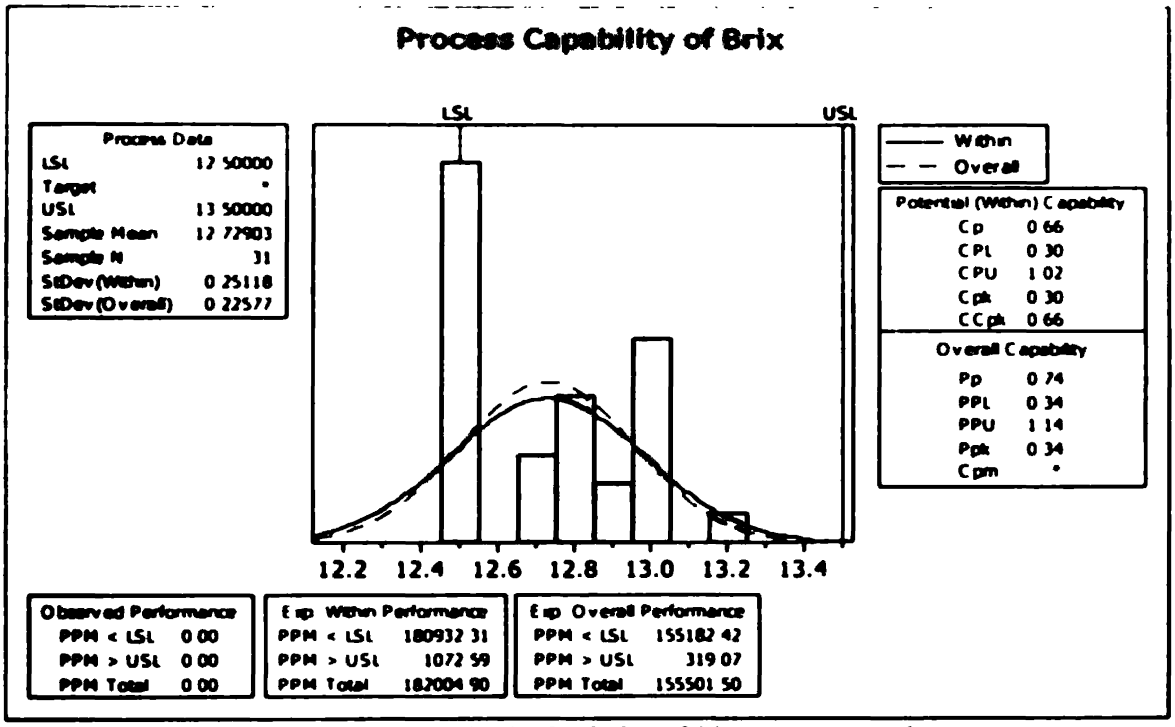

Fig. 4.16: Process capability analysis for brix of Shaa cream soda

Interpretation:

Cp = 0.66

1.0 >= Cp

Process capability is inadequate; improvements should be made.

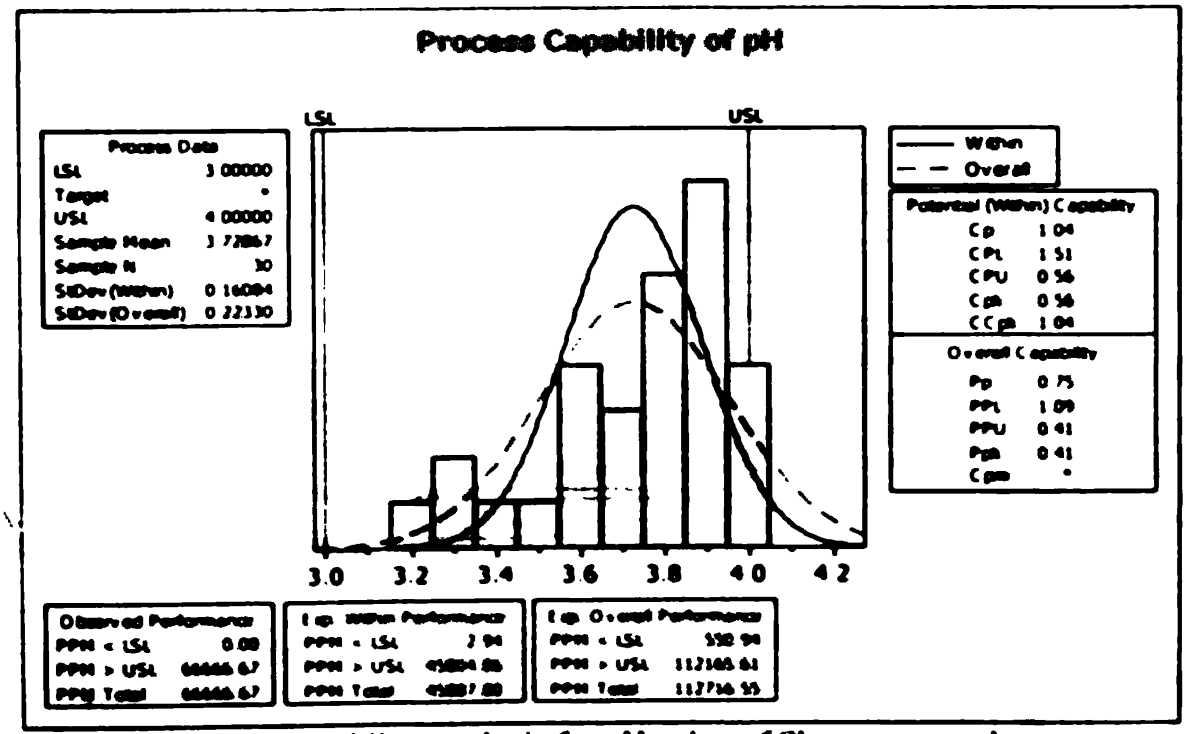

Fig. 4.17: Process capability analysis for pH value of Shaa cream soda

Interpretation:

Cp = 1.04

1.33 >= Cp > 1.0

Process is acceptable but process capability does not completely meet specifications; process control should be continued.

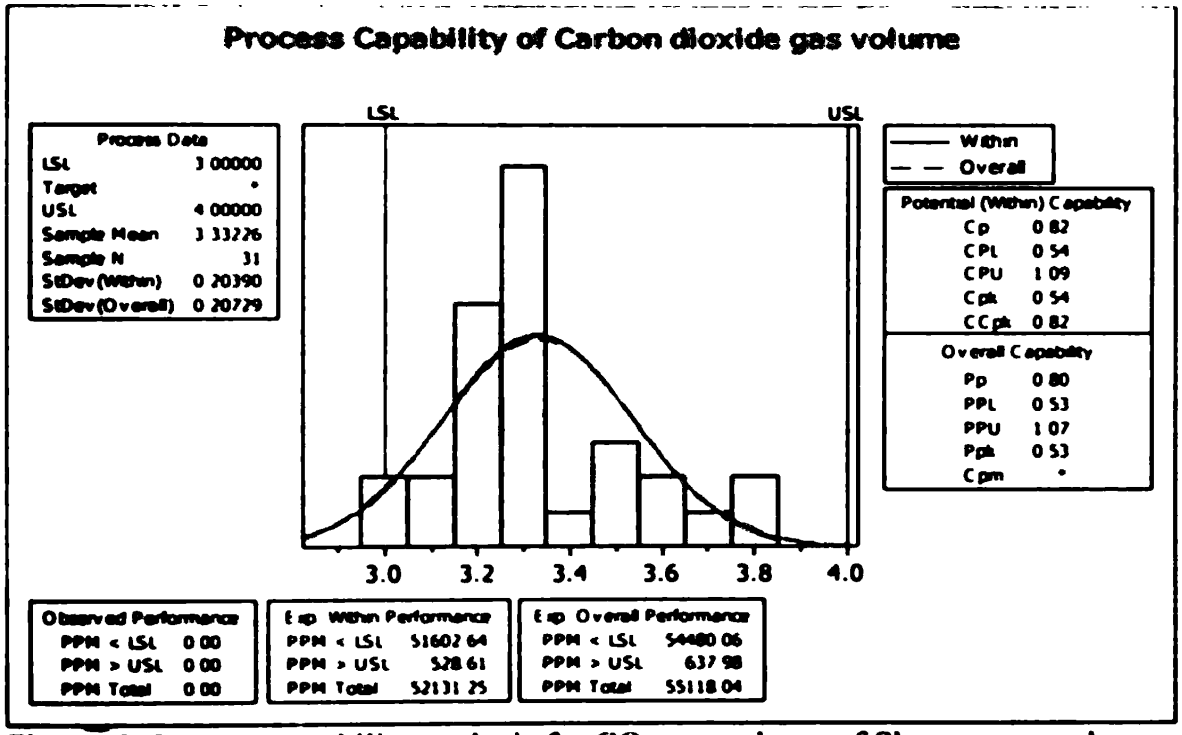

Fig. 4.18: Process capability analysis for CO_2 gas volume of Shaa cream soda

Interpretation:

Cp = 0.82

1.0 >= Cp

Process capability is inadequate; improvements should be made.

According to the process capability analysis for pH value, process is acceptable. Cp values for brix and CO_2 gas volume also near to 1.0. Therefore process becomes acceptable. But process capability does not completely meet specifications; process control should be continued.

Shaa lemonade

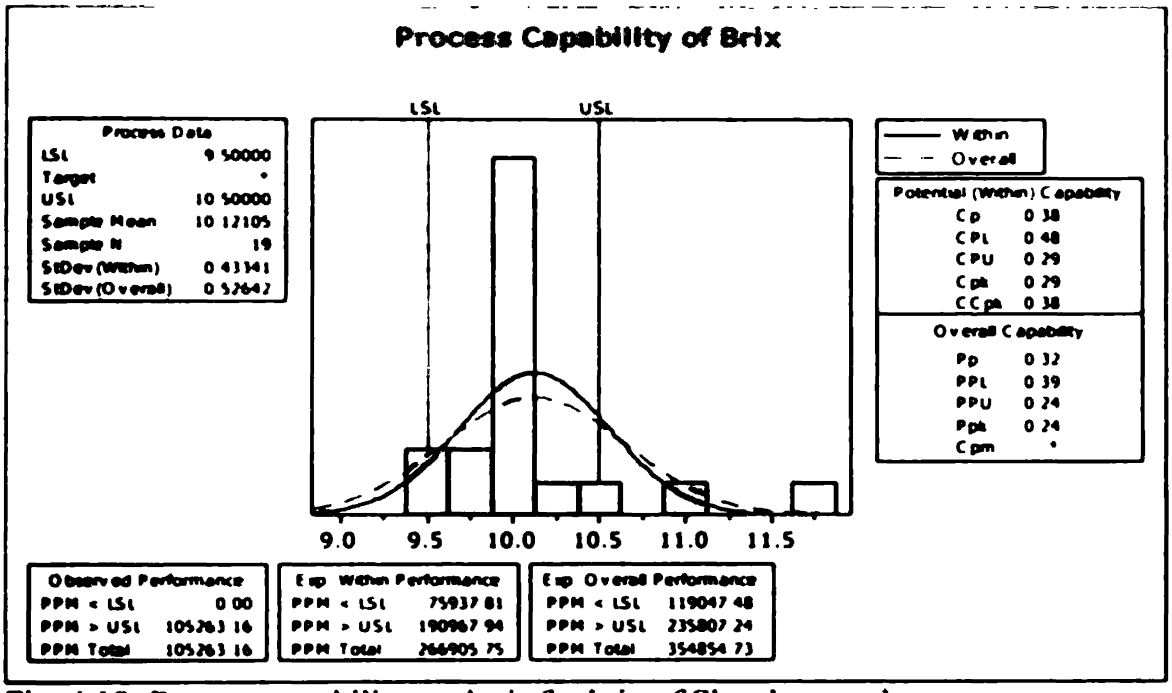

Fig. 4.19: Process capability analysis for brix of Shaa lemonade

Interpretation:

Cp = 0.38

1.0 >= Cp

Process capability is inadequate; improvements should be made.

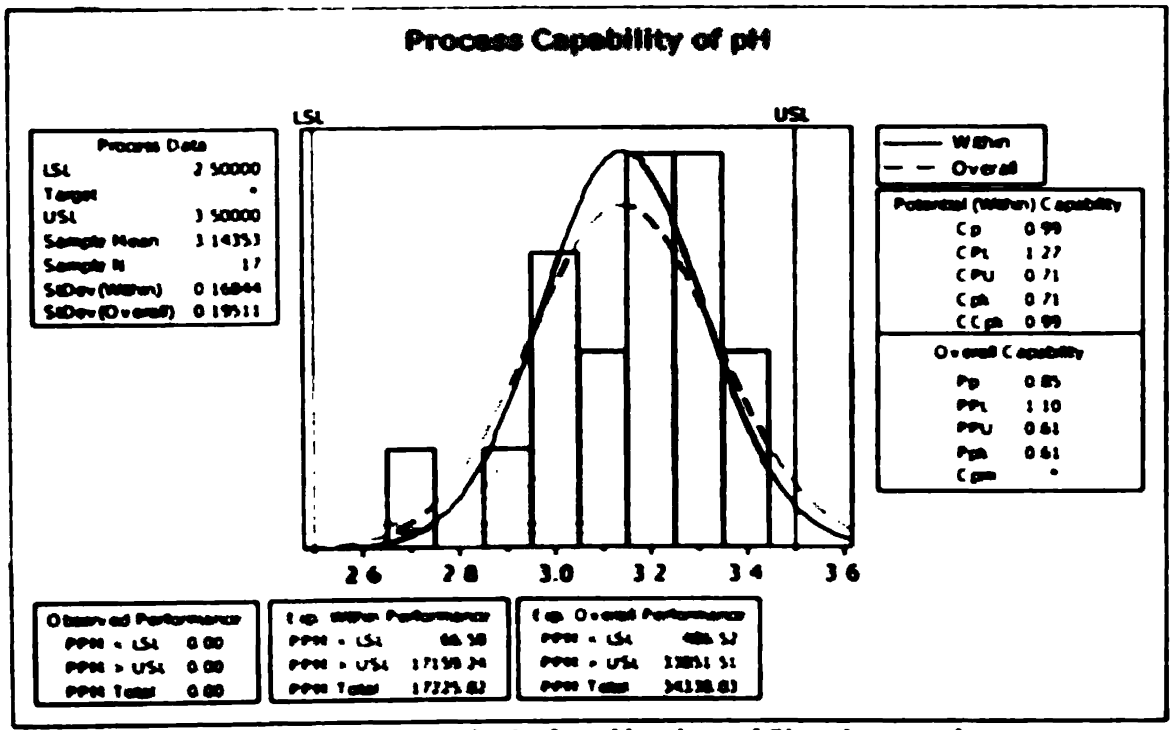

Fig. 4.20: Process capability analysis for pH value of Shaa lemonade

Interpretation:

Cp 0.99

1.0 > Cp

Process capability is inadequate; improvements should be made.

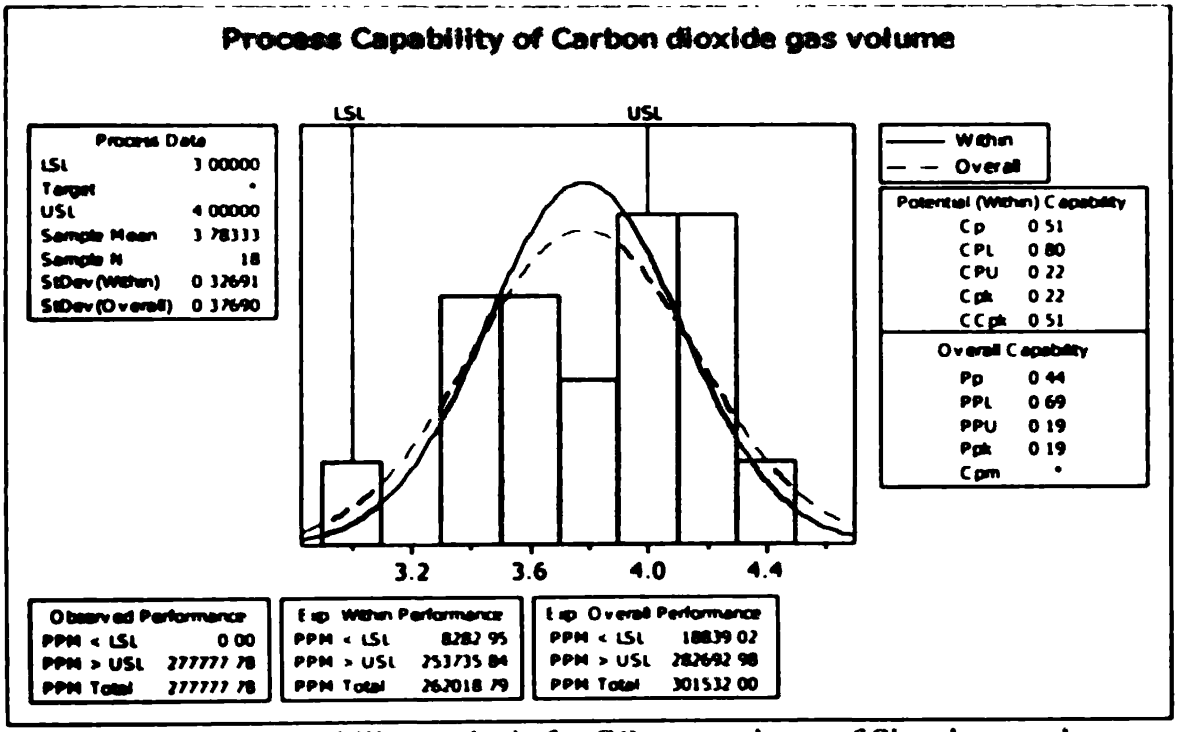

Fig. 4.21: Process capability analysis for CO_2 gas volume of Shaa lemonade

Interpretation:

Cp = 0.51

1.0 >= Cp

Process capability is inadequate; improvements should be made.

Shaa lemonade process capability is inadequate for brix, pH value and CO_2 gas volume. Therefore improvements should be made for lemonade production process.

Microbiological test results for raw water

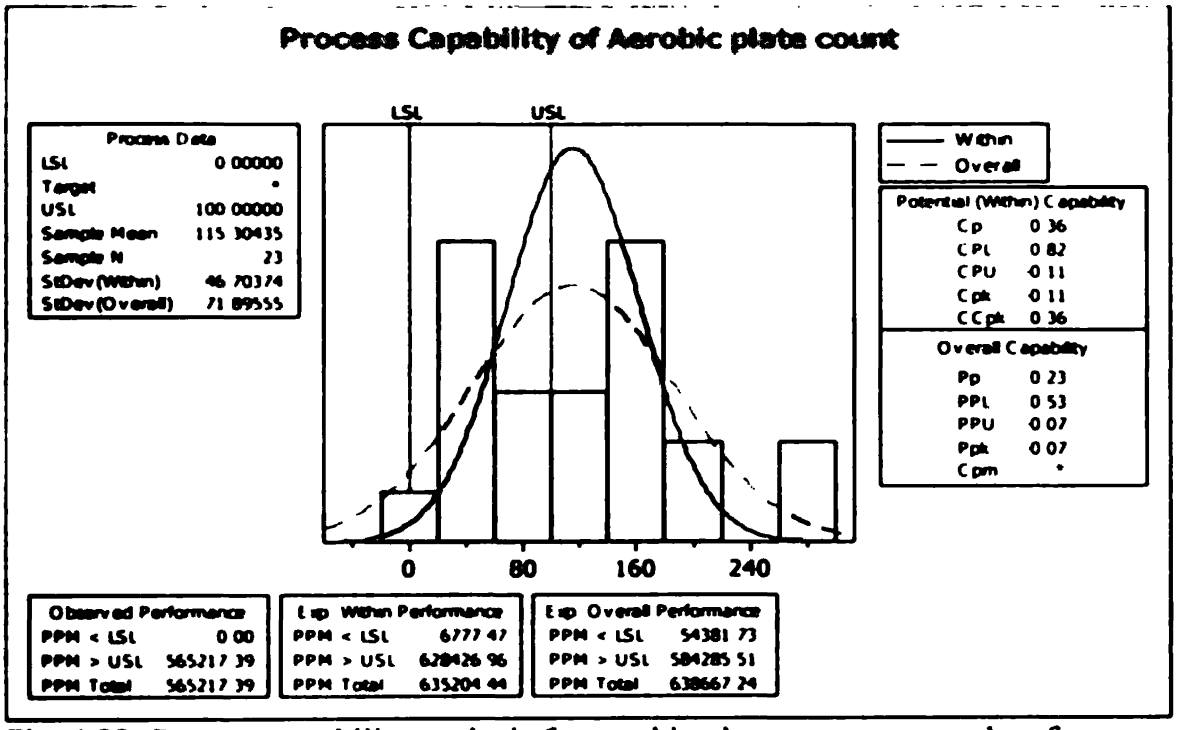

Fig. 4.22: Process capability analysis for aerobic plate count test results of raw water

Interpretation:

Cp = 0.36

1.0 >= Cp

Process capability is inadequate; improvements should be made

Total coliform count and E.coli count in raw water was not detected (Appendix M). But process capability of aerobic plate count test is inadequate. Therefore improvements should be done by improving environment hygiene as well as personal hygiene.

4.13Verification and improvement of food safety management system

Food safety plan for the carbonated beverage process and internal audit plan were developed to complete the verification procedure of food safety management system.

Food safety plan for the carbonated beverages process

Table 4.7: Food safety plan for the carbonated beverages process

Process step	Monitoring parameters	Frequency	Responsibility	Standard	Records	Remarks
1. Raw material receiving						
• Raw water	Chemical quality	Once a month	QAM	SLS 614 part1	OPRP/RRI/01/Form	
	Microbiological quality	Once a week	QAM	SLS 614 part2		
	pH of raw water	Once a day	Lab assistant	SLS 614 part1		
	Few chemical parameters (pH,turbidity,conductivity)	Once a week	Lab assistant	SLS 614 part1		
• Sugar	OPRP/RRI/03/List	Once received	QAM, Lab assistant, Supervisor, Receiving officer	Supplier assessment	OPRP/RRI/03/Form	
• CO_2	OPRP/RRI/02/List					
• Flavours, Emulsions, Acids, colours & preservatives	OPRP/RRI/03/List & OPRP/RRI/04/List					
• PET bottles & lids	OPRP/RRI/05/List					
2. Raw water filtration	Pressure of the gauge	Once a day	Supervisor	-	-	

	Turbidity of water	Once a day	Lab assistant	SLS 516 part 1 SLS 614 part 2	OPRP/RRI/02/Form	
3. Water UV sterilization	Function of UV bulb Changing of the UV bulb	Hourly Replace the UV bulb after finishing recommended working hours(9000hrs).	Supervisor Factory engineer	- -	Working hours of UV bulb – log sheet Changing of UV bulb – log sheet	
4 Water chilling	Chilling temperature	Hourly	Supervisor	-	OPRP/CPM/01/Form	
5. Sugar dissolving	Physical observation (total dissolved sugar)	Every batch	Supervisor	-	-	
6. Sugar filtration	Pressure of the gauge	Once a day	Supervisor	-	-	
7. Ingredient weighing	Weight of the ingredients	Every batch	Supervisor	-	OPRP/SRM/01/Form	
8. Mixing ingredients with sugar solution	Brix, Temperature and pH	Every batch	Supervisor	-	OPRP/SRM/02/Form	
9. Syrup chilling	Chilling temperature	Hourly	Supervisor	-	OPRP/CPM/02/Form	
10 Carbonation &	Gas volume, brix, pH	Hourly	Lab assistant	-	OPRP/CPM/03/Form	

adjusting brix						
11.Filling & capping	Capping strength	Hourly	Supervisor	-	Machine maintenance records	
12.Finished product						
• Immediately after the production	Physical quality	Every batch	Lab assistant	OPRP/FPI/02/List	OPRP/FPI/01 Form	
	Chemical quality	Once a month	QAM	SLS 183: 1997	OPRP/FPI/01 Form	
	Microbiological quality	Once a week	QAM	SLS 183: 1997	OPRP/FPI/01/Form	
• At market place	Chemical quality	Once in three month	QAM	SLS 183: 1997	OPRP/FPI/02/Form	
	Microbiological quality	Once in three month	QAM	SLS 183: 1997	OPRP/FPI/02/Form	
• After shelf life	Chemical quality	Once in three month	QAM	SLS 183: 1997	OPRP/FPI/03/Form	
	Microbiological quality	Once in three month	QAM	SLS 183: 1997	OPRP/FPI/03/Form	

Internal audit plan

Food safety team leader should plan the audit and he is responsible for appoint the auditors and auditees. Auditors have responsible for give the answers for auditee's questions. Auditees should be appointed from other department and he should be prepared questions before starting the audit. Internal audit should be arranged once in three months.

Once finished the internal audit, food safety team leader arrange the opening meeting with the auditees to find out non conformities that are having with each departments. Once audit is completed, get auditee to specify the corrective action to be taken for each non- conformity giving the required time period will be corrected. Finally audit findings and corrective action reports should be return to the management representative.

Table 4.8: Internal audit schedule

Department	ISO 22000:2005 Relevant Clauses	Auditee	Auditors	Time			
				March	June	Sep.	Dec.
1.Production							
NCR							
2. Quality Assurance Dpt.							
NCR							
3. Receiving and purchasing Dpt							
NCR							
4. Stores							
NCR							

CHAPTER 05

Conclusions and Recommendations

5.1 Conclusions

- PRPs were developed by considering each and every process steps and production areas.
- By identifying biological, chemical and physical hazards in the carbonated beverage process, following Control Points (CPs) and Critical Control Points (CCPs) were determined.
    - Control Points (CPs)
        - Raw material Receiving
        - Ingredient weighing
        - Sugar dissolving
        - Sugar filtration
        - Water filtration
        - Carbonation
        - Storage and dispatch of bottles
    - Critical Control Points (CCPs)
        - Raw water sterilization
        - Bottle capping
- Operational prerequisite Programs (OPRPs) and Hazard Analysis Critical Control Point (HACCP) plan were established according to the identified CPs and CCPs.
- Under the process capability analysis of CO_2 gas volume, brix and pH; cola, mandarin and cream soda production processes were identified as barely acceptable processes and soda, lemonade production processes should be improved according to their specifications.
- Total coliform count and E.coli count in raw water was not detected. According to aerobic plate count results, process capability of beverage process is inadequate. So improvements should be made.
- Food safety plan and internal audit plan was developed to verification of the food safety management system.

5.2 Recommendations

- PRPs, OPRPs and HACCP plan records should be maintained continuously.
- Introduction of machine for capping strength measurement is important.
- Comprehensive food safety management system verification should be carried out by maintaining food safety plan and internal audit plan.
- Gap analysis needed to be done by identified requirements with ISO 22000:2005 food safety management system requirements for the successful implementation of ISO 22000 to the carbonated beverage process.

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Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Calibrations
(C)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab Assistant	2
Supervisor	3

SHAA	ISO 22000:2005 Pre Requisite Programme (PRP) Calibrations	Section No: PRP 01 Date of Issue: Revision No: 00 Page No: 01 of 03
ISSUED BY	SIGNATURE	
APPROVED BY	SIGNATURE	

1. CALIBRATION OF REFRACTOMETER, THERMOMETER, PH METER, PRESSURE GAUGE, ANALYTICAL BALANCE AND ELECTRIC BALANCE

1.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain procedure for calibration of Refractometer, Thermometer, pH meter, Pressure meter, Analytical balance and Electric balance to assist in reducing the likelihood of introducing food safety hazards to the product throughout the work environment

1.2 Scope

Calibration procedure is applies to the Refractometer, Thermometer, pH meter, Pressure meter, Analytical balance and Electric balance used in the syrup room, production area and laboratory

1.3 Responsibility

The overall responsibility to establish, implement and maintain the calibration procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with lab assistant and supervisors

1.4 Calibration Policy

1.4.1 Third party calibrations

Refractometer, Thermometer, pH meter, Pressure gauge, Analytical balance and Electronic balance are calibrated once a year from an independent calibration laboratory.

1.4.2 List of calibrated instruments

PRP/C/01/List

Instrument	Location	Calibration range	Calibration certificate no. & date	Responsible person
1. Refractometer-1 Refractometer-2	Production area	10^{B} - 32^{B} 50^{B} – 65^{B}		
2. Thermometer	Production area	0 °C – 100 °C		
3. pH meter	Laboratory	2 5 – 7 0		
4. Pressure gauge	Production area	0 – 60 psi		
5.Analytical balance	Laboratory	0 01 g – 20g	DM/1439/2008 2008 07 22	
6. Electronic balance 1	Syrup room	1 kg – 14 5 kg		
7. Electronic balance 2	Syrup room	1 kg – 300 kg		

1.4.3 In house calibration

pH meter and Refractometer is calibrated once a month by lab assistant

PRP/C/01/Form

In house calibration reports – pH meter

Date of calibrated	Standards pH 2.00	pH 4.00	pH 7.00	Calibrated by	Remarks

PRP/C/02/Form

In house calibration reports – Refractometer1

Date of calibrated	Standards Brix 10^0	Brix 20^0	Brix 30^0	Calibrated by	Remarks

PRP/C/03/Form

In house calibration reports – Refractometer2

Date of calibrated	Standards Brix 50^0	Brix 60^0	Brix 65^0	Calibrated by	Remarks

1.5 Related documents

i. Calibration certificates
ii. List of calibrated instruments PRP C 01 List
iii. In house calibration reports (pH meter and Refractometer) PRP/C/01/Form, PRP/C/02/Form, PRP C 03 Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Cleaning and Sanitizing
(CS)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab Assistant	2
Supervisor	3

2. CLEANING AND SANITIZING

2.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain program for cleaning and sanitizing to assist in reducing the likelihood of introducing food safety hazards to the product throughout the work environment.

2.2 Scope

Cleaning and sanitizing program applies to the raw material storage area, syrup room, beverage production site and finished product storage area

2.3 Responsibility

The overall responsibility to establish implement and maintain the cleaning and sanitizing is vested with the Quality Assurance Manager while the functional responsibilities are vested with supervisors, lab assistant and cleaner.

2.4 Cleaning and sanitizing procedure

PRP/CS/01/List

Cleaning & sanitizing place/ item	How	Chemical used	Frequency	Who	records
1 syrup room & production area	1 Remove food soil 2 Wash & rub using potable water 3 Use detergent for further cleaning 4 Wash with potable water until complete removal of detergents	Detergent - Tepol	After the production	Helper	
2. water storage tanks, syrup tanks, pipelines & filling machine	1 Wash & rub using 10ppm chlorine water 2 Wash with potable water until complete removal of chlorine	Chlorine water	once a week	Helper	
	• Syrup tanks, pipelines & filling machine wash with potable water until complete removal of flavours and colours	———	After the each production	Helper	
3 filters	1 Pass 10ppm chlorine water through filters 2 Wash with potable water until complete removal of chlorine	Chlorine water	Once a month	Helper	

4 equipment used for beverage production	1 Remove food soil 2 Wash & rub using potable water 3 Use detergent for further cleaning 4 Rinse with potable water until complete removal of detergents	Detergent - Tepol	After the production	Food handler	
5. PET bottles	Wash using potable water coming through pressure guns of the machine	Potable water	During production	Machine operator	
6 plastic creates	1 Dip in to 20ppm chlorine water bath 2 Rub using a brush 3 Use detergent for further cleaning 4 Wash with potable water until complete removal of chlorine & detergent	Chlorine water Detergent - Tepol	Once a week	Helper	
7 tile floor	1 Wet the tile with detergent mixed water 2 Rub the floor with a brush 3 Mop out until all detergent goes out	Detergent – tile cleaner	Once a day	Cleaner	
8 walls & ceiling	1 For tile walls follow the above procedure 2 For masonry walls and ceiling clean the cob webs and dust in a suitable way	Detergent - tile cleaner	Once a week	Cleaner	
9 glass	1 Wet the glass with detergent mixed water 2 Rub the glass with a punch 3 mop out with other punch until all detergent goes out	Detergent – glass cleaner	Once a week	Cleaner	

2.5 Format for cleaning and sanitizing log – Syrup room & production area

PRP/CS/01/Form

Cleaning and sanitizing log – Syrup room & production area

Year.....
Month.....

Date	Areas							Sig
	Water storage tank	filters	Syrup room	Syrup storage tank	Production area	Filling machine	Packing area	

2.6 Related documents

i. Copy of detergent and sanitizer certificates
ii. Cleaning and sanitizing procedure PRP/CS/01/List
iii. Cleaning and sanitizing log – Syrup room & production area PRP/CS/01/Form

Appendix C

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Personal Hygiene
(PH)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab Assistant	2
Supervisor	3

3. PERSONAL HYGIENE

3.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain program for personal hygiene to assist in reducing the likelihood of introducing food safety hazards to the product throughout the work environment regarding the personal who has direct contact with the product.

3.2 Scope

Personal hygiene program applies to raw material handlers in syrup room and beverage handlers in production site

3.3 Responsibility

The overall responsibility to establish implement and maintain the personal hygiene is vested with the Quality Assurance Manager while the functional responsibilities are vested with supervisors and lab assistant

3.4 Personal Cleanliness

3.4.1 Bathing

- Workers must bathe daily
- Use of good soap is important to wash away sweat and dirt
- A good deodorant should be used after a bathe and undergarments should be changed every day

3.4.2 Hair

Hair can be a breeding ground for bactena found on the skin Employees are required to wear head coverings such as hair bands, nets or caps It helps to:

Keep hair out of food
Prevents contamination by staphylococci
Prevent long hair from getting entangled in machinery

- Hair should be neatly tied if long
- Hair length for men should be up to mid-ears
- Hair should be shampooed regularly
- Moustaches and beards should be clean and trimmed
- Men without moustaches and beards should be clean shaven

3.4.3 Eyes

- Eyes must be kept clean and washed frequently
- Rubbing of eyes should be avoided
- An employee suffering from sore eyes should no be allowed to work

3.4.4 Teeth and Mouth

- Teeth should be brushed twice a day
- Mouth should be rinsed well and gargling is a must after meal

3.4.5 Hands

Hands are possibly the most unsafe equipment in the chain of infection in the entire food production operation Therefore;

- hands should be free from cuts and abrasions It should be covered with waterproof dressing
- have nails manicured, preferably trimmed short and free from nail polish.
- refrain from wearing jewellery.

Hands should be washed,

- before beginning work and after a break
- before handling raw materials and foods
- after eating or smoking a cigarette
- after using the toilet
- after touching infected or unsanitary areas of the body or combing hair.
- after using a handkerchief, sneezing or coughing in to the hands.
- after handling money
- after scullery or any cleaning operation
- after handling waste food or refuse
- when ever hands are dirty

Proper hand washing procedure

1. Turn the water on and moisten the hands under the water
2. Apply liquid water using dispenser lathering well beyond the wrists and up the arms to the elbows
3. Pay special attention to the areas between the fingers and around the nails
4. Rub one hand against the other in a rotating motion using friction
5. Rinse thoroughly under the running water, allowing the water to flow from the elbows down to the fingertips
6. Turn water faucet off with a single service towel or your elbow or foot
7. Dry hands thoroughly with a hot air dryer or single service towel
8. Repeat this procedure as often as necessary

3.4.6 Uniforms, Caps and Masks

Each food handler is given 2 sets of uniforms, caps and masks Before starting each shift they should wear washed and sanitized uniforms with caps and masks

3.4.7 Medical examination

All the food handlers who has direct contact with food are subjected to medical examination once a year to make sure that they don't have communicable diseases.

3.5 Monitoring of personal hygiene

PRP/PH/01/Form

Personal hygiene check list

Month:.....

Employee no.	Name	Days per month(30 columns)	Signature of inspector

Checking for
N - Nails not Cleaned
W - Wounds and Earldoms
H -No proper combing and protectig to hair
S - Relocated due to sickness
J -Wearing hanging Jewellenes
R - Relocated one taken or production

* If the food handler shows above signs the relevant cage should be marked with letter or letters, which has been given above

3.6 Related documents

i. Medical certificates of food handlers
ii Personal hygiene check list PRP/PH/01/Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Pest Control
(PC)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab Assistant	2
Supervisor	3
Security officer	4

4. PEST CONTROL

4.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain pest control procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout the work environment

4.2 Scope

Pest control program applies to the entire building and the surrounding area of the factory.

4.3 Responsibility

The overall responsibility to establish implement and maintain the pest control procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with cleaner, supervisors and lab assistant.
The pest control program of the company has been out soused to a licensed pest control and janitorial service which is Sadow service

4.4 Chemicals used for pest controlling

Pest	Name of the chemical	Dosage	Mixing level
Cockroaches	Propoxur	100 ml	Add water up to 4 L and mix
Flies	Coopex	100 g	Add water up to10 L and mix
Mosquitoes	Baytex Ec & Cyslin Ec	50 ml	Add water up to 8 L and mix
Ants	Coopex	50 g	Add water up to 5 L and mix
Rat / Mice	Fentrol	50 g	Put the chemical in a Bait Tray and leave it in the area where the pest live
	Rat Glue	25 g	Paste the glue in a board and leave it in the area where the rats/mice live

4.5 Manufacturers specifications of material/chemicals used for pest controlling

Pest	Chemical	Formulation	Group	Antidote/Treatment
1. Rats / Mice	Fentrol	0 005% RB	Difeneacum Anti Coagulant	Vitamin K
2. Cockroaches	Propoxur	20% Ec Emulsified Concentrate	Organo Carbonate	Atropine Sulphate (Don't induce vomiting)
3. Mosquitoes	RBT	50% concentrate	Fernthrion	Symptomatic treatment
4. Flies	Coopex	WP Wettable Powder 25%	Permethrin	Symptomatic treatment
5.Flies	RBT	50% Emulsified Concentrate	Fernthrion	Symptomatic treatment
6.Flies –	Cislin	25% Ec	Delta Methrin	No specific Antidote

4.6 Method of controlling

4.6.1 Control of Rodents (Rats and Mice)

A plan for setting up barting stations throughout the premises using latest rodenticides will be prepared by a trained technician of Sadow service Checking and replenishing of barts as well as setting up additional basting stations will be identified by regular visits of pest controlling organization

4.6.2 Control of Cockroaches

Effective control is achieved by spraying a residual insecticide to all locations likely to be infused in the premises

4.6.3 Control of Ants

Spraying with a residual insecticide will be carried out to all locations likely to be infested internally and externally

4.7 Pest control operations

Pest control operations are carried out once a month by a trained technician of the pest control organization All the departments are informed about the date and time of the pest control operations All the staff members are made aware of the precautionary actions to be taken prior to the pest control operations

4.8 Identification of pests and their locations

The different types of pests and the potential locations for pest harborage are identified with the support of all the staff members. The form is made available in every department. This form is filled by staff members who notice pests or their locations and hand over to lab assistant. These records are used by pest control organization when they plan the programs

PRP/PC/01/Form

Pest identification form

Name of the pest or pest sign (droppings, foot marks etc)	
Location	
Date and time	
Action taken	
Name and signature of the staff member who notice the pest sign	
Signature of Lab Assistant	
Date reported to the pest control organization	
Corrective or preventive action	
Signature of pest controller	

SHAA	ISO 22000:2005 Pre Requisite Programme (PRP) Pest Control	Section No: PRP 4 Date of Issue: Revision No: 00 Page No: 04 of 04
ISSUED BY	SIGNATURE	
APPROVED BY	SIGNATURE	

PRP/PC/02/Form

Periodic check list of pest control program

Date:.....
Pest control service

Treatment area	Treatment method	Checked by
1.Production - syrup room - labeling & packing		
2. Stores - raw material storage - finish product storage		
3. Laboratory		
4. Security office		
5. Office		
4. Canteen		
5. Changing rooms		
6. Toilets		

4.9 Related documents

i. Copy of pest controller's certificate of registration
ii Pest identification form PRP PC 01 Form
iii Periodic check list of pest control program PRP PC/02/Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Suppliers Assessments
(SA)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Purchasing Manager	1
Assistant	2
iving Officer	3

5. SUPPLIERS ASSESSMENTS

5.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain procedure for Suppliers Assessment to assist in reducing the likelihood of introducing food safety hazards to the product throughout the work environment.

5.2 Scope

Suppliers Assessment procedure applies to all raw material suppliers.

5.3 Responsibility

The overall responsibility to establish implement and maintain the Suppliers Assessment procedure is vested with the purchasing manager while the functional responsibilities are vested with lab assistant and receiving officer

5.4 Method of Suppliers Assessment

The suppliers assessment questionnaire is circulated among suppliers by the purchasing manager twice a year for regular suppliers or at the time that new suppliers are recruited Filled questionnaires are evaluated by a supplier assessment committee nominated by the purchasing manager

The suppliers who are not certified for HACCP, ISO 9001 or at least for SLS product standards are audited by the nominated member of the company food safety audit team.

5.5 Suppliers Assessment Questionnaire

PRP/SA/01/Form

Name of the company .....
Contact person .....
Address:.....
Tel./ Fax/ e-mail .....
Name of the product supplied .....
Person responsible for food safety .....

Questions	Yes	No	Not applicable
1. Does the company operate a food safety management system? If yes attach a copy of food safety policy			
2. Has the company being certified for HACCP/ ISO9001/ SLS product certificate? If yes attach copy of certificates			
3. Do you evaluate the customers? What are the evaluation criteria?			
4. Does the company have products recall procedure? If yes attach a copy of it			
5. Is chemical/microbiological test carried out internal/external laboratory? If yes attach copy of reports			
6. Did you carry out staff training in food safety during last 3 months? If yes attach copy of training records			
7. Do you carry out internal audit on food safety?			
8. Do you have specifications for all raw materials that you use for production of supplement product?			
9. Has the company being inspected by a legal enforcement agency in the last 12 months? If yes attach copies of relevant documents			
10. Do you have distribution procedure? If yes attach a copy of it.			

Completed by
Designation
Date .....

5.6 Supplier Evaluation

The above questionnaires are evaluated by suppliers evaluation committee.

PRP/SA/02/Form

Supplier Evaluation Form

Supplier name:
Assessment date:

Questions	Evaluation marks		
	10	5	0
1. Does the company operate a food safety management system? If yes attach a copy of food safety policy			
2. Has the company being certified for HACCP/ ISO9001/ SLS product certificate? If yes attach copy of certificates			
3. Do you evaluate the customers? What are the evaluation criteria?			
4. Does the company have products recall procedure? If yes attach a copy of it			
5. Is chemical/microbiological test carried out internal/external laboratory? If yes attach copy of reports			
6. Did you carry out staff training in food safety during last 3 months? If yes attach copy of training records			
7. Do you carry out internal audit on food safety?			
8. Do you have specifications for all raw materials that you use for production of supplement product?			
9. Has the company being inspected by a legal enforcement agency in the last 12 months? If yes attach copies of relevant documents			
10. Do you have distribution procedure? If yes attach a copy of it			

Assessed by
Verified by
(purchasing manager)

5.7 Suppliers Evaluation Criteria

Suppliers who gain more than 65 marks are registered as raw material supplier for carbonate beverage production However the supplier who gains less than 65 has to be audited by the company audit team

5.8 Registered supplier list

The results of suppliers assessment is used for preparation of registered supplier list

PRP/SA/03/Form

Registered supplier list

Raw material	Registered supplier

5.9 Related documents

i. Suppliers assessment filled questionnaire PRP/SA/01/Form with relevant documents
ii. Supplier evaluation form PRP SA 02 Form
iii. Registered supplier list PRP SA 03 Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Waste and Sewage Disposal
(WSD)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab Assistant	2
Supervisor	3

6. WASTE AND SEWAGE DISPOSAL

6.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain waste and sewage disposal procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout the work environment

6.2 Scope

Waste and sewage disposal program applies to the entire factory

6.3 Responsibility

The overall responsibility to establish implement and maintain the waste and sewage disposal procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with cleaner and supervisors.

6.4 Waste water disposal

Waste water is directly connected to the waste water treatment plant and treated water is passed to the lake in the separated area away from the factory

6.5 Solid waste disposal

The entire solid wastes are collected separately Non degradable solid wastes (damage PET bottles, lids, cans, bags, etc) are recycled by sundry sale and degradable solid wastes are removed in to a separated place away from the factory premises which is under the supervision of Quality Assurance department
Solid wastes are removed from the production area twice a day

SHAA	ISO 22000:2005 Pre Requisite Programme (PRP) Waste and Sewage Disposal	Section No: PRP 6 Date of Issue: Revision No: 00 Page No: 02 of 02
ISSUED BY	SIGNATURE	
APPROVED BY	SIGNATURE	

PRP/WSD/01/Form

Waste and sewage disposal check schedule

Month & week

Area	Mon.	Tues.	Wed.	Thu.	Fri.	Sat.
1.Production - syrup room - labeling & packing						
2. Stores - raw material storage - finish product storage						
3. Laboratory						
4. Security office						
5. Office						
4. Canteen						
5. Changing rooms						
6. Toilets						

- Fully removed □
- Half △
- Not removed ☆

6.6 Related documents

i Waste and sewage disposal check schedule PRP WSD 01 Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Pre Requisite Programme
Water, Air and Energy Supply
(WAE)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Operational Manager	1
Technical Executive	2

SHAA	ISO 22000:2005 Pre Requisite Programme (PRP) Water, Air and Energy Supply	Section No: PRP 7 Date of Issue: Revision No: 00 Page No: 01 of 01
ISSUED BY	SIGNATURE	
APPROVED BY	SIGNATURE	

7. WATER, AIR AND ENERGY SUPPLY

7.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain water, air and energy supply procedure throughout the factory to assist in reducing the likelihood of introducing food safety hazards to the products by means of water, air and energy and also ensure that availability and adequacy

7.2 Scope

Water, air and energy supply procedure applies to the entire building and the surrounding area of the factory

7.3 Responsibility

The overall responsibility to establish implement and maintain the water, air and energy supply is vested with the Operational Manager while the functional responsibilities are vested with Technical Executive and electricians

7.4 Method of water, air and energy supply

	Method of supply	Records
1. Water	Water from tube well to storage tank and distribute throughout the factory	Cleaning and maintenance records of water distribution system and water test reports
2. Air	Natural air flow. Air ducts and Air condition machines	Preventive maintenance programs and records of air conditions and air ducts
3. Energy	Electricity from electricity board / generator	Preventive maintenance programs of the electric system

7.5 Related Documents

i. Cleaning and maintenance records of water distribution system and water test reports
ii. Preventive maintenance program documents and records of air conditions and air ducts
iii. Preventive maintenance program documents of the electric system

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Operational Pre Requisite Programme

Raw material Receiving and Inspection (RRI)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab assistant	2
Supervisors	3
Receiving officer	4

SHAA	ISO 22000:2005 Operational Pre Requisite Programme (OPRP) Raw material Receiving & Inspections	Section No: OPRP 1 Date of Issue: Revision No: 00 Page No: 01 of 07
ISSUED BY	SIGNATURE	
APPROVED BY	SIGNATURE	

1. RAW MATERIAL RECEIVING AND INSPECTIONS

1.1Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain raw material receiving and inspection procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout raw materials and transportation

1.2Scope

Raw material receiving and inspection procedure applies to the

- Water
- Carbon dioxide (cylinders)
- Sugar, acidualant and preservatives (bags)
- Colours, flavours, and emulsion (cans)
- PET bottles and lids
- Labels and corrugated boxes

1.3Responsibility

The overall responsibility to establish implement and maintain the raw material receiving and inspection procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with lab assistant, receiving officer and supervisors

1.4Raw material inspection procedure

All the raw materials (apart from the water) are purchased form the approved list of suppliers and packaging materials are purchased from fully owned subsidiaries of JC group of companies Inspection criteria are described as mentioned in the following table. Raw materials are inspected by lab assistant and once the inspection is finished the relevant record sheet should be filled

Other relevant raw materials are inspected by receiving officer and satisfactory, unsatisfactory conditions are mentioned in the invoice it self

SHAA	ISO 22000:2005 Operational Pre Requisite Programme (OPRP) Raw material Receiving & Inspections	Section No: OPRP 1 Date of Issue: Revision No: 00 Page No: 02 of 07
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Raw material	Mode of delivery	Supplier	Inspection criteria	Records
1.Water	Pipe lines	Tube well in the factory	OPRP/RRI/01/List	OPRP/RRI/01/Form OPRP/RRI/02/Form
2.Carbon dioxide (cylinders)	Lorry	Ceylon oxygen limited	OPRP/RRI/02/List	OPRP/RRI/03/Form
3.Sugar (bags)	Lorry	C W mackie PLC (sugar trading division	OPRP/RRI/03/List	OPRP/RRI/03/Form
4.Acidualant and preservatives (bags)	Lorry	CHEMaster International	OPRP/RRI/03/List	OPRP/RRI/03/Form
6.Colours, flavours and emulsions (cans)	Lorry	ABmaun lanka (pvt) limited	OPRP/RRI/04/List	OPRP/RRI/03/Form
7.PET bottles and lids	Lorry	609 packaging (pvt) limited	OPRP/RRI/05/List	OPRP/RRI/03/Form
8.Labels and corrugated boexs	Lorry	Fast printers. Midaya packaging (pvt) limited	OPRP/RRI/06/List	OPRP/RRI/03/Form

1.5Format for water inspection records

OPRP/RRI/01/Form

Water inspection records (Before treatment)

Date	Time	pH	Chemical Analysis	Microbiological Analysis	Comments	Signature

Chemical Analysis:
✓Satisfactory
x Unsatisfactory

Microbiological Analysis:
✓Satisfactory
x Unsatisfactory

PERMANENT REFERENCE
Saberagamuwa University Library

OPRP/RRI/02/Form

Water inspection records (After treatment)

Date	Time	pH	Chemical Analysis	Microbiological Analysis	Comments	Signature

Chemical Analysis:
✓Satisfactory × Unsatisfactory
Microbiological Analysis:
✓Satisfactory × Unsatisfactory

1.6 Format for inspection records

OPRP/RRI/03/Form

Inspection records

Delivery date	Time	Product	Product condition	Supplier	Expire date	Comments	Receipt signature

Product condition:
✓Satisfactory × Unsatisfactory

1.7 Water inspection criteria

Raw water inspected results were recorded in OPRP RRI/01 Form
Treated water (after filtration and sterilization) inspected results were recorded in OPRP/RRI/02/Form

OPRP/RRI/01/List

Chemical Analysis

Characteristics	Max. desirable level	Max. permissible level	Units
1. Colour	5 units	30 units	PCU
2. Odour	Unobjectionable	Unobjectionable	
3. Taste	Unobjectionable	Unobjectionable	
4. Turbidity	2 units	8 units	NTU
5. pH range	5 0 – 6 5	4 5 – 7 0	
6. Conductivity	750	3500	µs/Cm
7. Chloride	200	1200	mg/l
8. Alkalinity	200	400	mg/l

Microbiological Analysis

Test	Acceptance limit
1. Aerobic plate count per ml (48 hrs at 37 °C) (test is carried out according to SLS516:part1 1991)	< 1 0 × 10^4
2. Total coliforms count(MPN)per 100ml (test is carried out according to SLS614 part2 1983)	<10 per 100ml
3. E-coli count (MPN)per 100ml (test is carried out according to SLS614 part2 1983)	None in 100ml

1.8 Carbon dioxide (cylinders) inspection criteria

Observe the below mention parameters and recorded in OPRP RRI/03 Form

OPRP RRI/021.rst

- Leakages
- Carbon dioxide composition(mention in the label)
- Expire date(mention in the label)
- Weight of the cylinder(mention in the label)
- Any damages

1.9 Sugar, acidualant and preservatives (bags) inspection criteria

Observe the below mention parameters and recorded in OPRP/RRI/03/Form

OPRP/RRI/03/List

- Correct weight(mentioned in the label)
- Contaminations with dust, sand etc
- Expiry date(mention in the label)
- Any damages
- Moisture content(mention in the label)

Characteristics of sugar

Product name	White – fine granulated refine sugar
Colour	Max 45 ICUMSA
Moisture	Max 0 04%
Polarization	Min 99 9%
Reducing sugars	Max 0 04%
Sulphate ash	Max 0 02%
Mean aperture	Max 0 7 mm
Packaging	In 50 kilos net polylined polypropylene bags with machine stritched and fit for rough handling

Characteristics of acidualant

Product name	Ascorbic acid (E 300)
Appearance	White crystalline powder
Particle size	through 20 mesh min 95%
	through 100 mesh min 5%
Melting point	about 190°C
Loss of drying	=<0 1%
pH (5% w/v)	2 1 – 2 6

Product name	Citric acid (E 330)
Appearance	White crystalline powder

Product name	Sodium citrate (E 331)
Appearance	White crystalline powder

Characteristics of preservatives

Product name	Sodium benzoate (E 211)
Appearance	White powder

Product name	Sodium metabisulphate (E 223)
Appearance	White powder

1.10 Colours, flavours, and emulsion (cans) inspection criteria

Observe the below mention parameters and recorded in OPRP/RRI/03/Form

OPRP/RRI/04/List

- Expiry date(mentioned in the label)
- Leakages
- Swelling
- Rust
- Dent
- Abnormal odour/ colour/ texture
- Appearance

Characteristics of Colours

Colour type	sunset yellow (E 110)	Colour type	tartrazine (E 102)
Colour type	caramel colour		

Characteristics of flavours

Flavours type	dalandan flavour (nature identical)
Appearance	clear pale yellow green liquid
Flavours type	natural lemon flavour
Appearance	clear pale yellow liquid
Compounds	lemon extract. (R)-p-mentha-1,8-diene
Flavours type	cola part B flavour
Appearance	dark brown colour liquid
Compounds	ortho phosphonc acid. caffeine
Flavours type	tamannd flavour
Appearance	dark brown colour liquid
Compounds	2-furaldehyde
Flavours type	cream soda flavour
Appearance	clear light yellow liquid
Compounds	polypropylene glycol

Characteristics of emulsions

Emulsion type	cola emulsion
Appearance	dark brown colour liquid
Compounds	sulphur dioxide
Emulsion type	neutral clouding flavour
Appearance	white emulsion
Compounds	orange. sweet. ext

1.11 PET bottles and lids inspection criteria

Observe the below mention parameters and recorded in OPRP/RRI/03/Form

OPRP/RRI/05/List

PET bottles

Category	Weight	Height	Colour	Circumstances	
				Body area	Neck area
350 ml	22 3 g	18 5 cm	white & green	18.5 cm	8.0 cm
500 ml	28 3 g	23 0 cm	white & green	21 0 cm	8.0 cm
1500 ml	48 0 g	30 5 cm	white & green	28.5 cm	8.0 cm

Lids

Colour	Weight	Diameter	Circumstances
Green, red, orange, violet, ash and brown	2 8 g	3 2 cm	9.5 cm

1.12 Labels and corrugated boxes inspection criteria

Observe the below mention parameters and recorded in OPRP/RRI/03/Form

OPRP/RRI/06/List

Labels

Category	Length	Width	Diameter
350 ml (s°)	19 0 cm	4 0 cm	9.5 cm
350 ml (p°)	19 5 cm	4 0 cm	9 75 cm
500 ml (p°)	21 6 cm	4 5 cm	10 8 cm
1500 ml (p°)	30 3 cm	7 2 cm	15 15 cm

s° -shrink label p° - print label

Corrugated boxes (3 Ply)

Category	Length	Width	Height
350 ml	36 2 cm	23 7 cm	19 3 cm
800 ml	38 9 cm	27 0 cm	23 7 cm
1500 ml	36 8 cm	27 2 cm	32 0 cm

1.13 Related documents

i Registered supplier list PRP SA 03 Form
ii Water inspection records OPRP RRI 01 Form and OPRP/RRI/02/Form
iii Other raw material inspection records OPRP RRI/03 Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Operational Pre Requisite Programme

Syrup Room Management
(SRM)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab assistant	2
Supervisors	3

2. SYRUP ROOM MANAGEMENT

2.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain syrup room management procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout the syrup room including syrup preparation area and storage tanks

2.2 Scope

Syrup room management procedure applies to the entire syrup room including syrup preparation area and storage tanks

2.3 Responsibility

The overall responsibility to establish implement and maintain the syrup room management procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with lab assistant and supervisors.

2.4 Syrup room operational practices

Workers should follow the below mention operation practices to work efficiently

- Flow the 'FIFO' (First In First Out) method when using raw material for syrup preparation
- Half of the sugar/preservatives/acidualant bags should be seal well and keep in a dry place
- Colours, flavours and emulsion cans should be closed tightly
- Separate syrup storage tanks should be maintained for each category
- Sugar dissolving should be done throughout the required time period and do not store over time in to the tank

2.5 Cleaning and Sanitizing

After the preparation of syrup, all the equipments and entire syrup room should be cleaned well

Once finish the production as well as before start the production, all the pipe lines and machines should be washed properly

Procedure reference No PRP 02

2.6 Ingredient weighing

All the ingredients used for preparation of each syrup should be weighed accurately by the trained person or experienced person and record it under OPRP/SRM/01/Form

2.7 Calibration of Electric balance, pH meter, Refractometer and Thermometer

Procedure reference No PRP 01

2.8 Sugar syrup filtration

Prepared sugar solution should be filtered using 0 5 µm filter and filters should be change according to the PRP 02

2.9 Syrup operational conditions in the storage tanks

i Brix range of syrup storage tank should be 60° - 65°
ii Temperature range of syrup storage tank should be 9°C – 11°C
iii. pH range of syrup storage tank should be 2 5 – 4 0

2.10 Format for amount of ingredients used per each syrup

OPRP/SRM/01/Form

Amount of ingredients list (per each syrup)

Date	Time	Type of beverage	Ingredients	Amount	Signature (prepared person)

2.11 Format for syrup operational conditions monitoring log

Monitor the syrup operational conditions in the storage tank and record it under OPRP/SRM/02/Form by supervisor.

OPRP/SRM/02/Form

Syrup operational conditions monitoring log

Date	Time	Syrup storage tank no.	Type of beverage	Brix	Temp.	pH	signature

2.12 Related documents

i Amount of ingredients list OPRP SRM 01 Form
ii Syrup operational conditions monitoring log OPRP/SRM/02/Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Operational Pre Requisite Programme
Filtration Process Management
(FPM)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab assistant	2
Supervisors	3

4. FILTRATION PROCESS MANAGEMENT

4.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain filtration process management procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout the filtration

4.2 Scope

Filtration process management procedure applies to the raw water filtration and sugar syrup filtration system

4.3 Responsibility

The overall responsibility to establish implement and maintain the filtration process management procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with lab assistant and supervisors.

4.4 Raw water filtration process

Sand filter, Activated carbon filter, 0 5 micron filters and 0 2 micron filters are used for raw water filtration process

4.5 Sugar syrup filtration process

0.5 micron filters are used for sugar syrup filtration process

4.6 Cleaning of filters

Before start the production, pressure gauge should be checked by the supervisor and if it is exceeded more than 1bar filters should be cleaned
Sand filter and active carbon filter cleaning is carried out by washing the media using a reverse flow of water and backwashing the floc out of the filter to drain

4.7 Changing of filters

Filters should be changed if,

- Visible particles in filtered water
- Turbidity of filtered water is exceeded more than maximum permissible level
- Off tastes in filtered water
- Patches, torn areas or any damages in micron filters

4.8 Format for Changing of filters

OPRP/FPM/01/Form

Changing of filters

Filters	month / year	(12 columns)			
Water filtration					
Multiple Media Filter					
Active carbon Filter					
0.2 Micron Filter					
0.5 Micron Filter					
Syrup filtration					
0.5 Micron Filter					

4.9 Related documents

i. Changing of filters log sheet OPRP/FPM/01/Form
ii. Water inspection records (After treatment) OPRP/RRI/02/Form

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Operational Pre Requisite Programme

Carbonation Process Management (CPM)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab assistant	2
Supervisors	3

3. CARBONATION PROCESS MANAGEMENT

3.1 Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain carbonation process management procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout the carbonation.

3.2 Scope

Carbonation process management procedure applies to the carbonation section.

3.3 Responsibility

The overall responsibility to establish implement and maintain the carbonation process management procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with lab assistant and supervisors.

3.4 Carbonation process handling practices

Trained person/ experienced person should be appointed for handling of carbonation process.

Water chiller temperature (10 °C) and syrup chiller temperature (8 – 9 °C) should be recorded in OPRP/CPM/01/Form and OPRP/CPM/02/Form hourly by supervisor.

Gas volume, Brix and pH should be recorded in OPRP/CPM/03/Form hourly by lab assistant and if any deviations occur from the inspection criteria under the OPRP/CPM/01/List, lab assistant should be informed to the supervisor/ appointed person immediately

Carbon dioxide cylinders should be changed by the technician under the supervision of the supervisor

3.5 Inspection criteria for each carbonated beverage

OPRP/CPM/01/List

Beverage type	Gas volume range	Brix range	pH range
Mandarin	2.5 - 3.5	12.0 – 13.0	2.5 – 3.5
Cola	4.0 – 5.0	9.5 – 10.5	2.0 – 3.0
Lemonade	3.0 – 4.0	9.5 – 10.5	2.5 - 3.5
Tamarind	3.0 - 3.5	12.5 – 13.0	2.5 – 3.5
Cream soda	3.0 – 4.0	12.5 – 13.5	3.0 – 4.0
Soda	4.0 – 4.5	-	4.0 – 4.5

3.6 Format for inspection records

OPRP/CPM/01/Form

Inspection records (Water chiller)

Date	Time	Temperature

OPRP/CPM/02/Form

Inspection records (Syrup chiller)

Date	Time	Beverage type	Temperature

OPRP/CPM/03/Form

Inspection records (During production)

Date	Time	Beverage type	Gas volume	Brix	pH	Signature

3.7 Calibration of Refractometer, Thermometer, pH meter, Pressure meter

Procedure reference No PRP 01

3.8 Related documents

i. Inspection criteria for each carbonated beverage OPRP/CPM/01/List

ii. Inspection records OPRP/CPM/01/Form, OPRP/CPM/02/Form and OPRP/CPM/03/Form

Appendix I.

Shaa Cola Beverage (Pvt) Limited

ISO 22000:2005

Operational Pre Requisite Programme
Finished Product Inspection
(FPI)

Issue Date:
Revision No:
Controlled Copy No:

Copy Holder	Copy No.
Quality Assurance Manager	1
Lab assistant	2
Supervisor	3

SHAA	ISO 22000:2005 Operational Pre Requisite Programme (OPRP) Finished Product Inspection	Section No: OPRP 5 Date of Issue: Revision No: 00 Page No: 01 of 05
ISSUED BY.	SIGNATURE	
APPROVED BY	SIGNATURE	

1. FINISHED PRODUCT INSPECTION

1.1Objectives

Shaa Cola Beverage (Pvt) Limited shall establish, implement and maintain finished product inspection procedure to assist in reducing the likelihood of introducing food safety hazards to the product throughout production, storage, transportation and market place.

1.2Scope

Finished product inspection procedure applies to the

- Finished products (immediately after the production)
- Finished products (at the market place)

1.3Responsibility

The overall responsibility to establish implement and maintain the finished product inspection procedure is vested with the Quality Assurance Manager while the functional responsibilities are vested with lab assistant and supervisor

1.4Finished product inspection procedure

1.4.1Finished products (immediately after the production)

The number of bottles to be selected from a lot accordance with OPRP/FPI/01/List.

OPRP/FPI/01/List

Scale of sampling

Number of bottles in the lot	Number of bottles to be selected	Size of the sub sample
Up to 500	8	4
501 to 1200	10	5
1201 to 3200	12	6
3201 to 10,000	15	6
10,001 and above	20	10

1.4.1.1 Physical parameters

Samples (selected finished products accordance with OPRP/FPI/01/List) were inspected daily according to OPRP/FPI/02/List.

OPRP/FPI/02/List

Parameters List

A. Label (accordance with SLS 467)
   - Name of the product
   - Registered trade mark or brand name, if any
   - Batch or code number
   - Name and address of the manufacturer and/or distributor
   - Volume of the contents in liters or milliliters and
   - Date of expiry (optional)

B. Leakages (Closer Leakage Test accordance with S L S 714 –1985)
   - Selected bottles were kept within 2 hours in up side down and checked for leakages

C Damages (Drop Test accordance with S L S 714 – 1985)
   - Selected bottles were dropped down.
   - a vertically in normal way (bottom touched with floor)
   - b vertically in up side down way (closure touched with floor)

1.4.1.2 Chemical parameters

Samples (selected finished products accordance with OPRP/FPI/01 List) were tested for chemical parameters once in three months from third party laboratory (SLS 183 1997)

Samples (selected finished products accordance with OPRP/FPI/01 List) were tested for chemical parameters once in six months from Sri Lanka Standard Institution (SLS 183 1997)

OPRP/FPI/03/List

Preservatives

Characteristic	Requirement	Method of test
1. Benzoic acid mg/kg. max *	160	SLS 581
2. Sulfur dioxide mg/kg. max **	70	SLS 581

* *When a product contains more than one preservative the quantity of each preservative expressed as a percentage of the maximum permitted limit of the preservative shall be calculated. The sum of these percentages shall not exceed 100*

** *Products packed in metal containers shall not contain sulfur dioxide*

OPRP/FPI/04/List

Heavy metals

Heavy metals	Limit	Method of test
1. Arsenic, mg/kg, max	0.2	SLS 312
2. Copper, mg/kg, max	2	SLS 301
3. Lead, mg/kg, max	0.2	SLS 311

1.4.1.3 Microbiological parameters

Samples (selected finished products accordance with OPRP/FPI/01/List) were tested for microbiological parameters once a month from third party laboratory (SLS 183 1997)

Samples (selected finished products accordance with OPRP/FPI/01 List) were tested for microbiological parameters once in three months from Sri Lanka Standard Institution (SLS 183.1997)

OPRP/FPI/05/List

Microbiological criteria

Test	Limit	Method of test
1 Standard plate count, per ml, max	100	SLS 516 : part 1
2 Coliforms, per ml	Absent	SLS 516 : part 3
3 Yeast and moulds count per ml	Absent	SLS 516 : part 2

1.4.2 Finished products (at the market place)

Samples at the market place (selected finished products accordance with OPRP FPI/01/List) were tested for chemical and microbiological parameters once in six month from third party laboratory (SLS 183 1997)

1.5 Format for Finished product(immediately after the production) inspection records

OPRP/FPI/01/Form

Finished product (immediately after the production) inspection records

Date	Product type	Physical parameter				Chemical parameters		Microbiological parameters	Remarks	Signature
		A	B	C		Preservatives	Heavy metals			
				a	b					

Physical Parameters:
✓ Satisfactory × Unsatisfactory
Chemical Parameters:
✓ Satisfactory × Unsatisfactory
Microbiological Parameters:
✓ Satisfactory × Unsatisfactory

1.6 Format for Finished product (at market place) inspection records

OPRP/FPI/02/Form

Finished product (at market place) inspection records

Date	Product type	Chemical parameters		Microbiological parameters	Remarks	Signature
		Preservatives	Heavy metals			

Chemical Parameters:
✓ Satisfactory × Unsatisfactory
Microbiological Parameters:
✓ Satisfactory × Unsatisfactory

1.7 Identification of shelf life

Shelf life of the carbonated drink is six months. Samples were kept for a period of six months and tested for chemical and microbiological parameters to verify the shelf life.

OPRP/FPI/03/Form

Shelf life verification records

Date	Product type	Chemical parameters		Microbiological parameters	Remarks	Signature
		Preser-vatives	Heavy metals			

Chemical Parameters:

✓Satisfactory × Unsatisfactory

Microbiological Parameters:

✓Satisfactory × Unsatisfactory

1.8 Related documents

i. Scale of sampling OPRP/FPI/01/List

ii. Physical, Chemical and Microbiological parameters OPRP/FPI/02/List, OPRP/FPI/03/List, OPRP/FPI/04/List, OPRP/FPI/05/List

iii. Finished product (immediately after the production) inspection records OPRP/FPI/01/Form

iv. Finished product (at market place) inspection records OPRP/FPI/02/Form

v. Shelf life verification records OPRP/FPI/03/Form

Brix, CO_2 gas volume and pH values for shea cola

Date	Time	Brix	CO_2	pH
1/10/2008	1 30	9 8	4 9	2 70
	3 30	10 0	4 6	2 63
2/10/2008	8 50	10 0	4 5	2 59
	10 40	9 8	4 5	2 96
	2 30	10 0	4 7	2 27
	4 00	10 0	4 1	2 49
8/10/2008	9 50	9 9	4 9	2 82
	10 55	10 0	4 6	2 88
	12 30	10 0	4 4	2 89
	1 30	10 0	4 6	2 88
	2 30	10 0	4 8	2 86
	3 40	10 0	4 5	2 75
10/10/2008	10 00	10 0	4 5	2 88
	11 40	9 5	4 6	2 41
	2 15	10 0	4 3	2 66
	3 45	10 0	4 6	2 53
16/10/2008	2 00	10 5	4 6	2 53
	3 00	10 3	4 6	2 41
	4 30	10 2	4 4	2 51
17/10/2008	7 55	11 0	4 8	2 49
	9 05	11 0	4 6	2 43
	11 30	10 0	4 8	2 85
	12 05	10 0	4 5	2 68
	1 35	10 2	4 4	2 84
	3 30	10 2	4 8	2 66
	4 30	10 0	4 2	•
27/10/2008	12 40	9 4	4 7	2 81
	2 50	10 5	4 5	2 78
	4 20	10 0	4 3	2 70
3/11/2008	2 50	10 2	4 8	2 90
	4 45	10 2	4 6	•
4/11/2008	8 20	9 2	4 6	2 32
	9 40	10 0	4 5	2 82
5/11/2008	8 30	9 8	4 2	2 80
	9 45	9 0	4 4	2 68
	11 20	9 4	4 8	2 86
	12 50	10 2	4 6	2 74
	1 50	10 4	4 8	2 79
	3 50	10 2	4 5	2 67
	4 50	10 0	4 6	2 56
6/11/2008	11 50	9 8	4 6	2 85
	2 30	9 8	4 8	2 72

7/11/2008	8 30	10 0	4 7	2 49
	9 30	10 0	4 5	2 55
	10 40	10 4	4 4	2 85
	12 05	10 4	4 5	*
	1 40	10 0	4 4	2 45
	4 30	10 0	4 2	2 70
21/11/2008	9 15	9 4	4 5	2 25
	12 25	9 6	4 3	2 71
	2 25	10 0	4 2	2 56
	3 45	10 0	4 3	2 68
	4 40	10 0	4 2	2 46
22/11/2008	11 15	10 0	4 6	2 52
	2 30	10 0	4 2	2 87
	4 30	10 0	4 5	2 68
25/11/2008	8 50	10 0	5 0	2 38
	10 00	10 0	4 5	2 22
4/12/2008	8 30	10 0	4 7	2 59
	9 30	9 5	4 8	2 52
	11 00	10 0	4 0	2 79
	4 10	10 0	4 8	2 59
11/12/2008	1 50	10 4	4 6	2 68
	2 50	10 2	4 5	2 36
	4 15	9 8	4 5	2 60
13/12/2008	8 50	10 5	4 8	2 53
	1 15	9 5	4 3	2 72
	2 15	10 4	4 3	2 74
	3 30	10 2	4 6	2 57
17/12/2008	1 10	10 0	4 8	2 78
	2 40	10 0	4 5	2 65
	3 30	10 0	4 6	2 52
	4 50	10 2	4 5	2 65
20/12/2008	11 00	10 0	4 8	2 55
	12 10	10 0	4 6	2 65
	2 20	10 0	4 6	2 53
	4 05	10 0	4 5	2 25
23/12/2008	8 00	10 5	4 7	2 61
	11 00	10 8	4 6	2 64

Brix, CO_2 gas volume and pH values for Shaa mandarin

Date	Time	Brix	CO_2	pH
3/10/2008	9 35	12 5	2 9	3 20
	11 00	12 5	3 1	3 27
	12 30	12 5	2 9	3 17
	1 15	12 5	2 8	3 12
	2 50	13 0	3 0	3 00
	3 40	12 5	2 8	2 98
4/10/2008	8 45	12 2	2 9	3 27
	10 30	12 5	2 9	3 10
	2 30	12 6	2 7	3 19
	3 40	12 5	2 6	2 79
15/10/2008	9 50	12 5	3 0	3 11
	11 15	12 5	3 2	3 14
	2 15	11 9	3 0	2 84
	4 00	11 8	2 9	2 78
	4 55	12 5	2 9	3 00
3/11/2008	11 00	12 8	2 7	3 47
	12 20	12 0	2 6	3 40
13/11/2008	2 30	12 1	2 7	3 05
	3 30	13 0	2 7	2 85
	4 45	12 5	2 7	2 76
19/11/2008	8 50	12 5	2 7	2 66
	4 55	12 5	2 8	•
5/12/2008	10 45	12 2	2 8	2 88
	11 45	12 5	2 9	2 88
	2 10	12 5	2 6	3 20
	3 20	12 8	2 9	3 00
22/12/2008	1 30	13 4	2 8	2 97
	2 40	12 5	2 5	2 95
	3 50	12 5	3 1	3 06
	4 50	12 0	2 7	3 05

Brix, CO_2 gas volume and pH values for Shaa soda

Date	Time	Brix	CO_2	pH
1/10/2008	11 00		4 5	4 10
6/10/2008	11 30		4 3	4 40
16/10/2008	8 20		4 4	3 78
	10 00		4 4	3 79
	11 30		4 5	4 24
	1 00		4 5	4 22
18/10/2008	9 10		4 6	3 72
	12 30		4 6	4 22
30/10/2008	3 40		4 7	4 12
3/11/2008	1 45		4 5	4 21
6/11/2008	10 45		4 4	3 93
10/11/2008	12 50		4 6	4 02
	2 50		4 5	4 07
	3 55		4 5	3 93
	4 45		4 1	3 86
13/11/2008	9 05		4 2	3 71
24/11/2008	9 20		4 2	3 61
	1 40		4 5	3 76
8/12/2008	11 15		4 8	3 97
	12 15		4 7	4 13
9/12/2008	11 40		4 8	4 41
	1 30		2 9	•
	2 30		4 9	3 62
	3 40		3 4	4 32
10/12/2008	8 45		4 2	3 80
	9 50		4 3	4 00
16/12/2008	1 45		4 2	4 13
	3 50		4 5	•
17/12/2008	11 40		4 5	4 10
19/12/2008	11 20		4 5	3 86
	12 55		4 5	3 74

Brix, CO_2 gas volume and pH values for Shaa cream soda

Date	Time	Brix	CO_2	pH
22/10/2008	11 00	12 5	3 8	3 32
	1 00	12 7	3 3	3 66
	2 20	13 0	3 0	3 89
	3 30	12 5	3 3	3 87
	4 45	12 5	3 1	
31/10/2008	9 00	13 0	3 8	3 89
	10 15	12 7	3 5	3 75
	11 15	12 5	3 5	3 82
	1 00	12 8	3 2	3 77
1/11/2008	9 30	13 0	3 6	3 55
	11 50	12 9	3 3	4 01
	1 50	13 0	3 2	4 01
	3 00	12 5	3 1	3 93
	4 45	12 5	3 2	3 53
14/11/2008	9 55	12 8	3 5	3 58
	11 55	12 5	3 3	3 85
	12 55	13 2	3 3	3 86
	2 20	12 5	3 6	3 89
20/11/2008	9 45	12 8	3 3	3 94
	12 10	12 9	3 2	3 95
	2 30	12 5	3 2	3 36
	3 40	12 7	3 7	3 26
8/12/2008	1 00	12 5	3 2	3 62
	1 45	12 5	3 3	3 68
	2 50	12 8	3 2	3 75
	4 00	12 5	3 3	3 80
	4 45	13 0	3 3	3 96
9/12/2008	8 15	13 0	3 4	3 74
	9 15	12 5	3	3 57
	10 20	12 8	3 3	3 83
19/12/2008	4 45	13 0	3 3	3 22

Brix, CO_2 gas volume and pH values for Shaa lamonade

Date	Time	Brix	CO2	pH
6/10/2008	2 30	9 8	3 8	3 30
	3 30	10 0	4 4	3 32
	4 40	10 0	3 5	2 71
7/10/2008	9 30	10 1	4 1	2 98
	11 00	10 1	4 2	3 17
	1 00	10 0	4 2	3 43
	2 40	10 0	3 9	3 24
	3 50	10 0	3 7	*
20/10/2008	1 50	9 5	3 6	*
	4 20	10 0	3 4	2 90
21/10/2008	8 55	9 5	3 4	3 00
	10 30	10 5	4 1	2 98
30/10/2008	9 10	11 8	3 0	3 26
	10 10	10 0	3 6	3 18
6/12/2008	8 30	10 2	4 0	3 08
	9 40	9 8	4 0	3 43
	11 20	10 0	3 9	3 25
8/12/2008	8 50	11 0	*	3 16
18/12/2008	4 20	10 0	3 3	3 05

Microbiological test results for raw water

Date	Aerobic plate count	Coliform	E coli
7/7/2008	94	none	none
	38	none	none
	32	none	none
	58	none	none
	33	none	none
3/9/2008	140	none	none
	160	none	none
	180	none	none
	140	none	none
	260	none	none
12/10/2008	270	none	none
31/10/2008	92	none	none
	160	none	none
	180	none	none
	58	none	none
	120	none	none
23/12/2008	120	none	none
	160	none	none
	150	none	none
	64	none	none
	110	none	none
26/12/2008	20	none	none
	13	none	none

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