Sudan University of Science and Technology

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Quality Evaluation of Different Brands of Barley Soft Drink in Khartoum State Markets

تقييم جودة ماركات مختلفة من مشروب الشعير الغازي بأسواق ولاية الخرطوم

By

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بسم الله الرحمن الرحيم

جامعة السودان للعلوم والتكنولوجيا

كلية الدراسات العليا

تقييم جودة ماركات مختلفة من مشروب الشعير الغازي بأسواق ولاية الخرطوم

إعداد

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بكالوريوس (التغذية وتكنولوجيا الأغذية)

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الآيـــــــة

قال تعالى :

﴿ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ ﴾

صدق الله العظيم

سورة المجادلة – الآية (١١)

Dedication

I dedicate this research to all whom assist me

To my supervisor

To my all friends

To my family

Acknowledgement

I am very grateful to Almighty Allah for giving me health and mind to complete this research .

I am indebted gratefully to my supervisor

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Abstract

This study was designed to evaluate the quality of barley soft drinks produced by four factories in Khartoum state. Barley soft drinks were collected from different markets and the factories immediately after production and stored under different conditions (refrigeration, room temperature and direct sun light for sixth months). All samples were physicochemically, chomically and sensory evaluated. The results revealed that the sugar percentages (brix) of the fresh products after production ranged from 11.31 to 11.81%, and reminds table there was no without any change during storage under the different conditions. White the Co_2 volume after production ranged from 3.14 to 3.95% , but during the storage periods, under refrigeration, room temperature, direct sun light and market condition ranged 1.99 - 3.61 , 1.99 - 3.56, 1.71-3.51, respectively.The titerable acidity immediately after production ranged from 0.14 to 0.19% and during the storage period under refrigeration ,room temperature, direct sun light and market condition ranged from 0.13 - 0.21,0.12-0.21,0.12-0.24 and 0.12-0.21% respectively. The pH immediately after production ranged 3.09 to 3.56 and during the storage period under refrigeration ,room temperature, direct sun light and market condition ranged from 3.01 - 3.72,3.01-3.81,2.91-3.96 and 3.01-

3.81% respectively. The benzoic acid concentration immediately after production ranged from 0.01 to 0.07% and there was no any change during the storage period (sixth months) under different conditions. Alcohol was not found in all samples stored under different conditions ,but protein content was found to range in the fresh product from 2.14 to 2.95 and during the storage period under refrigeration ,room temperature, direct sun light and market condition ranged from 2.06 - 2.61,2.21-2.51,1.71-2.25 and 2.21-2.51% respectively.The content of heavy metals Iron ,copper and zinc and lead in barley soft drinks in all factories under different condition were found to be within the range specified by the EC (1995).Also the barley soft drink products stored under the different conditions were found to be free from yeasts and molds during the different storage periods. The total bacterial counts of the product immediately after production was found to be negligible, but and under refrigeration ,room temperature, direct sun light and market condition were $5.0x10^2$,$9x10^2$,and $9x10^3$ c.f.u/ml respectively .The results of the sensory evaluation revealed that the general appearance was not changed for 3 months in all samples under different storage conditions, but it was less acceptable after 6 months, especially in the market samples .The colour also, was not changed in all samples that collected from under different factories and stored under refrigeration ,room temperature, and sun light, for 6 month, but in regenerl to the sample that collected from the market the colors was found deteriorated with the storage period. The taste did not change in 3 factories, but deteriorated in one factory and market samples after 3 months of storage. The potassium bromide was not found in all samples stored under different conditions.

الملخص

صممت هذه الدراسة بغرض تقويم جودة مشروبات الشعير الغازية المنتجة بواسطة أربعة مصأنع محلية في ولاية الخرطوم .تم تجميع العينات من أجل الدراسة من الأسواق ومن المصأنع بعد الإنتاج مباشرة ثم تم التخزين تحت ظروف مختلفة (التبريد و درجة حرارة الغرفة و درجة حرارة الشمس المباشرة لمدة ستة أشهر). كل العينات حللت فيزيوكيميائيا,وكيميائي ثم قومت حسيا. أظهرت النتائج أن نسبة السكر(البركس) بعد الإنتاج مباشرة كانت في المدى ١١.٣١ الى ١١.٨١% وانه لم يحدث تغير لنسبة السكر خلال الفترات التخزينية تحت الظروف المختلفة بلغ حجم غاز ثاني أكسيد الكربون ٣.١٤ الى ٣.٩٥ % بعد الإنتاج مباشرة و عند التخزين تحت التبريد وعند درجة حرارة الغرفه وتحت أشعة الشمس المباشرة وفي الأسواق المختلفة ١.٩٩ الى ٣.٦١ % ، ١.٩٩الى ٣.٥٦ ، ١.٧١الى٣.٥١ ، ١.٩٩ الى ٣.٥٦ %. بلغت الحموضة العياريه للمنتج ٠.١٤ الى٠.١٩ % بعد الإنتاج مباشرة و عند التخزين تحت التبريد وعند درجة حرارة الغرفه وتحت أشعة الشمس المباشرة وفي الأسواق المختلفةعلي التوالي، بلغت نتائج الاس الهيدروجيني للمنتج بعد الإنتاج مباشرة ٠.١٤ الى٠.١٩ % و خلال فترة التخزين تحت التبريد،و درجة حرارة الغرفة، وتحت أشعة الشمس المباشر وفي الاسوق المختلفة تراوحت بين ٠.١٣ - ٠.٢١ ، ٠.١٢ -٠.٢١ ، ٠.١٢ - ٠.٢٤ و٠.١٢-٠.٢١،٠٪على التوالي اما حامض البنزويك بعد الإنتاج مباشرة كان ٠.٠١ الى ٠.٠٧ ولم وليس هناك أي تغيير خلال فترة التخزين (أشهر السادسة) في ظل الظروف ألمختلفة. أظهرت النتائج ان منتجات الشعير السودانيه خاليه من الكحول بعد الإنتاج وخلال الفترات التخزينية (ستة اشهر) في ظل الظروف المختلفة.ولكن تم العثور على محتوى البروتين يتراوح في المنتجات الطازجة ٢،١٤-٢،٩٥ وخلال فترة التخزين تحت التبريد، درجة حرارة الغرفة، وعلى ضوء الشمس المباشر وفي السوق تراوحت ٢،٠٦-٢،٦١ ، ٢.٢١-٢.٥١ ، ١.٧١-٢.٢٥ و ٢،٢١-٢،٥١٪ محتوى علي التوالي محتوى العناصر الثقيله الحديد والنحاس والخارصين والرصاص في مشروبات الشعير الغازيه في كلّ المصانع تحت

الظروف المختلفِ ضمن المدى المحدّدَ من قبل المجموعة الأوربيةِ . أظهرت التحاليل المايكروبية خلو المنتج من الخمائر والأعفان بعد الإنتاج وفي الظروف التخزينية وخلال الفترات التخزينية المختلفة. ووجد ان العد الكلي للبكتريا في المنتج بعد الانتاج مباشرة قليل جدا"(negligible) وعند التخزين تحت التبريد خلال الفترات التخزينية المختلفة العد الكلي للبكتريا ٥.٠×١٠^{٣}/ملي وعند التخزين تحت درجة حرارة الغرفة العد الكلي للبكتريا ٥.٠×١٠^{٣}/ملي وعند التخزين تحت اشعة الشمس المباشرة كان العد الكلي للبكتريا ٥.٠ ×10^3/ملي. أظهرت نتائج التقويم الحسي أن مظهرالمنتج لم يتغير لمدة٣ شهور في كل العينات تحت كل الظرؤف ولكن بعد ٦ شهور أصبح أقل قبولا" خاصة في عينات السوق. اللون لم يتغير في كل العينات من المصانع تحت كل الظرؤف لمدة ٦ شهور ولكن عينات السوق كانت في تدهور بطول مدة التخزين .الطعم لم يتغير في ٣ مصانع الاأنه تدهور في أحد المصانع وعينات السوق بعد ٣ شهور من التخزين . يمكن إالاستنتاج أن كل المصانع ماعدا واحد أعطت نتائج متشابهة ،في حين أن عينات السوق سجلت نوعا" من التدهور في الصفات الحسية ولم يتم العثور على بروميد البوتاسيوم في جميع العينات المخزنة في ظل الظروف مختلفة.

Chapter One

Chapter One

1. Introduction

Carbonated beverages are consumed by consumers of all age groups for different reasons like taste refreshment, relaxation pleasure, sociability and brands of carbonated beverage (soft drinks) at present.Unfortunately, most of the carbonated drinks contain synthetic coloring and flavouring agents which may be potentially allergic (Kaushal *et al* . 2004).The term soft drinks, encompasses all non-alcoholic beveragese except for coffee tea and milk based products.Now a day’s soft drink represent a substantial proportion of liquid in take with large per capita consumption per year (Kourtis and Arvanitoyaunis, 2001). The assurance of safe production and supply of adequately safe and healthy food products appear to be the main aims of the food industry section. These aims can be attained by adopting a systematic and organized controlling activities, procedures and resources according to the standards which constitute the basis for the total quality systems including ISO 9000 series and the Hazards Analysis Critical Control Points (HACCP) system (Banat *et al* . , 2004).Malta which is also called young beer, children's beer, or wheat soda is a type of soft drink. It is a carbonated malt beverage, meaning it is brewed from barley, hops, and water much like beer; corn and caramel colours may be added. However, malt is non-alcoholic, and is consumed in the same way as soda or cola in its original carbonated form, and to some extent, iced tea in non-carbonated form (Parryd *et* *al.,* 2001). Recently for the first time in Sudan Muawiya Albrair Company in 2009 introduced carbonated beverage from barley. This product is called (Champion) the product found some sort of acceptable and become popular by the consumers. Later many factories are involved in production of this drink, but, many questions are raised about its contents e.q. alcohol content and the effect of the different storage conditions which may affect the beverage quality. The aim of this study was to evaluate the quality of different types of barley soft drinksproduced by Sudanese soft drink componies.

General Objective:

To evaluate the quality of different types of Sudanese barley soft drinks.

Specific Objectives:

- To determine physicochemical and chemical properties of the product.
- To determine mineral contents of the beverage
- To determine the number and types of microorganisms dominating in the soft drink.
- To evaluate the quality of the product from different source under different storage coditions.

Chapter Two

Chapter Two

2. Literature Review

2.1 Soft drinks:

2. 1.1 Defintion

Soft drinks contain treated water, sugar or sweeteners, coloring compounds, flavoring a gents, acidifiers, carbone dioxide and preservatives (Guerrero *et al.* , 1999).

2.1.2 Soft drinks and health

Pharmacists in America and Europe experimented with myriad ingredients in the hope of finding new remedies for various ailments. Already, the flavored soda waters were hailed as brain tonics for curing headache and nervous affliction (Nickerson, 1972).

Soft drinks help settle upset stomachs, modern theory holds that the carbonation is responsible for this setting effect. Many doctors recommend adding ½-1 ½ liters of water daily when fever is present chilled carbonated beverages provide the additional fluids in a form that renders them more acceptable than ordinary water in fever and other diseases accompanied by intense thirst'. Also reported that many doctors recommend soft drinks to children and adults when other foods and liquids cannot be tolerated . Besides increasing liquid intake, they are effective in lessening nausea and gastric distress. A survey of 380 hospitals showed that over 85% of them used soft drinks routinely; 271 use carbonated beverages to alleviate post operative and pregnancy nausea, 244 use carbonated beverages when no other food can be tolerated; 188 use carbonated beverages to insure adequate liquid intake; 185 use carbonated beverages as a between meal beverage, 126 use carbonated beverages to aid digestion, 56 use carbonated beverage to facilitate administration of milk in febrile cases. They also, reported that doctors even prescribe soft drinks some times for colds and to prevent virus infection (Wood Roof *et al* ,. 1974).

2.1.3 Classification of barely soft drinks:

Soft drinks are mainly classified into the following categories:

2.1. 4 Ready to drink beverages:

Most ready to drink beverages are carbonated .These are usually prepared from a concentrated syrup containing sugar (and possibly saccharin) , fruit juice (or flavoring essence) , citric acid or phosphoric acid and preservative (usually sodium benzoate). Artificial coloring matter is added to some drinks and products such as ginger beer containing a foaming agent (Kourtis and Arvanitoyannis, 2001).

2.1. 5 Squashes, cordials, crushes:

Concentrated soft drinks contain more or less similar ingredients to the ready to drink beverage but in greater a mounts. They are, however, not carbonated. Most products should remain cloudy on storage provided that pasteurized juice has been used. Squashes containing fruit juice usually contain sulfur dioxide as preservative (Banat *et al.* , 2004).

2.1. 6 Comminuted drinks:

Prepared from whole citrus fruit rather than the juice, although some of the insoluble solids are usually removed by sieving . The common preservative used is sodium benzoate (Banat *et al.* , 2004).

2.1. 7 The harmful effects of soft drinks:

Most of the soft drinks contain a high concentration of simple carbohydrates, such as, glucose, fructose, sucrose and other simple sugars. Oral bacterial ferment carbohydrates and produce acid, which dissolves tooth enamel during the dental decay process, thus, sweetened beverage likely to increase risk of dental caries. The risks are greater if the frequency of consumption is high (Guerrero *et al.* , 1999).

A large number of soft drinks are acidic and some have a pH of 3.00 or even lower. Drinking acidic drinks over a long period of time and can therefore erode the tooth enamel. Drinking through a straw is often advised by dentists as the drink is then swallowed from the back of the mouth and does not come into contact with the teeth. It has also been suggested that brushing teeth right after drinking soft drinks should be avoided as this can result in additional erosion to the teeth due to the presence of acid ,there is a hypothesis that phosphoric acid contained in some soft drinks (colas) displaces calcium from the bones, lowering bone density of the skeleton and leading to conditions such as osteoporosis and very weak bones (Rodgers, 1999).

Major soft drink companies had documentations of benzene contamination in soft drinks since at least 1990. it was originally thought that ,the contamination was caused by contamination carbon dioxide , but research has shown, that benzoates and ascorbic acid or ery-thorbic acid can reacts to produce benzene (Wood Roof *et al* ,. 1974).

In 2006 , the Food Standards Agency published the results of its survey of benzene level in soft drinks which listed 150 products and found that four contained benzene levels above the world health organization (WHO) guide lines for drinking water. The United States Food and Drug Administration released its own list of results of several soft drink and beverages contained benzene levels above the environmental protection agencies recommendation stander.

Areport the (Nwaiwu,2006) demonstrated that some soft drinks contain measurable amounts of alcohol. In some older , preparations , this resulted from natural fermentation used to build the carbonation modern drinks use introduced carbon dioxide but alcohol might result from fermentation of sugars in a UV sterile environment.

2.2 Barley soft drinks:

2.2.1 Defintion

Barley soft drinks contain treated water, sugar or sweeteners, coloring compounds, flavoring a gents, acidifiers, Carbone dioxide and preservatives (Guerrero *et al.* , 1999).

Barley Soft drinks are enormously popular beverages consisting primarily of carbonated water, barley ,sugar, and flavorings. barley Soft drinks rank as America's favorite beverage segment, representing 257% of the total beverage segment, representing 25% of the total beverage market .The first imitation mineral water in the U.S was patented in 1809; it was called soda water' and consisted of water and sodium bicarbonate mixed with acid to add CCP effervescence (Nickerson, 1972).

Barley originated in Ethiopia and Southeast Asia, where it cultivated for more than 10,000 years. Barley was used by ancient civilizations as a food for humans and animals, as well as to make alcoholic beverages; the first known recipe for barley wine dates back to 2800 BC in Babylonia. In addition, since ancient times, barley water has been used for various medicinal purposes (Dosorsier *et al.* , 2000).

Barley played an important role in ancient Greek culture as a staple bread-making grain as well as an important food for athletes, who attributed much of their strength to their barley-containing training diets. Roman athletes continued this tradition of honoring barley for the strength that it gave them. Gladiators were known as hordearii, which means "eaters of barley." Barley was also honored in ancient China as asymbol of male virility sincethe heads of barley are heavy and contain numerous seeds (Erkkila *et al.,* 2005).

Since wheat was very expensive and not widely available in the Middle Ages, many Europeans at that time made bread from a combination of barley and rye. In the 16th century, the Spanish introduced barley to South America, while the English and Dutch settlers of the 17th century brought it with them to the United States. Today, the largest commercial producers of barley are Canada, the United States, the Russian Federation, Germany, France Spain (Dosorsier *et al.* , 2000).

2.2.2 Ingredients of barley soft drinks:

2.2.2.1 Water:

Water represents almost 90% of the total volume of a soft drink. In specifying standards for water for soft drinks; it is obvious that the water should have no impurities of any nature or kind to interfere with proper taste and color. Physical appearance and carbonation of the product such as standards are in general:

- The raw supply must be an unquestionable sanitary source. (It can be approved city supply).

- There must be an adequate supply with sufficient and uniform pressure.
- Total mineral solids shall not exceed 500ppm or be of the type and the amount to impart an undesirable taste. Freedom from iron sulfur, and manganese required.
- The alkalinity should not exceed fifty ppm or three grains per gallon.
- Water should have a very low content or preferably be free of taste, odor and objectionable organic matters, or such other matters of this nature as might be derived from industrial waste.
- The water must be free of turbidity, sediment and suspended matter.

It is essential that the water used in the production line comply with standards set by directive 80/777EEC for potable water (Kourtis and Arvanitoyannis, 2001).

Fifty water samples were collected in Khartoum state from different sources and investigated with multiple tube fermentation technique for total coli forms and with membranes filtration technique for fecal coli forms only. Results of the study showed that the thermo tolerant coli forms were detected in 60% of the samples from tap water of wells source and in only 30% of sample from tap water of river source. Thermo tolerant coli forms were also detected in 10% water samples from periodically cleaned water tanks and 20% water sample from uncleaned tanks (Ali, 2005).

2.2.2.1.1 Water treatment:

The water treatment in many soft drinks factories consists essentially of:

- Removal of color and suspended matters.
- Reduction of hardness
- Elimination of UV desirable bacteria, if water of high purity is already available, such as mineral springs, polishing by filtration may be the only treatments necessary (Herschdoerfer, 1987).
- Most water requires chemical treatment and general practice is to employ coagulation systems in which a coagulant from a gelatinous flock absorb foreign organic matter.

lime also reduces the alkalinity, Iron or aluminum salts are used as the coagulant. Chlorine kills all microorganisms and also oxidizes some of the impurities (Herschdoerfer , 1987).

The chlorine is then removed by activated carbon (which also removes any undesirable off taste) and this is normally preceded by sand filtration to ensure no contaminations or blockage of the carbon by fine sludge particles of ferric or aluminum hydroxide (Herschdoerfer, 1987).

To achieve a final polish to the water, it is pumped through high efficiency 1-micron filters to ensure every drop of treated water is free from any particular contamination and is safe for use in beverages: (CSE,2003).

The sterilization of water by ultraviolet radiation is found to have an advantage over chemical dosing as there is no chemical contamination problem (Herschdoerfer , 1987).

Alternative methods of water treatments are available, including reduction of alkalinity by hydrogen ion exchange, sterilization and color removal by ozone treatment and more recently the development of membrane filtration and the reverse osmosis process for demineralization .The final selection of the treatment process will relate to the quality of the water supply and the economics of the system available (Herschdoerfer, 1987) .

Full demineralization is seldom considered necessary for process water used in the soft drinks industry unless the supply water contains an excessive salts concentration . Even this case fully de-mineralized water itself is unsuitable as product water for beverages and blending with quantity of filtrate water is required to restore abase level of saline constituents (Herschdoerfer, 1986).

2.2.1.1.2 Water treatment in barley soft drinks factory:

The water treatment systems, in Barley soft drinks factory consist of the following units:

2.2.2.1.2.1 Raw water unit:

The water used for general industrial purposes usually comes from well resources. This first stage of treating water is injection of the water by chlorine, because it is cheap and kills most of bacteria in the water. Also chlorine used to remove any color by color less process, which it occurs according to the equation:

$2H_2O + 2CL_2 \rightarrow 2HCLO + 2HCL$

$2HCLO \rightarrow 2HCL + O_2$

The oxygen which is produce is very active and is used to remove the color. The concentration of chlorine must be more than three ppm and this is known by the addition of certain chemical indicators such as orthotoludine, which is a white substance that when added to the water treated with chlorine, the white color change in to bright yellow, this means that the concentration of chlorine in raw water is more than three ppm which can be detected by colorimeter (Herschdoerfer, 1986).

2.2.2.1.2.2 Filtration unit:

Water in soft drinks barley factory contains many molecules and ions in solution which can be removed by a filtration system. This system contains two filters(Herschdoerfer, 1986):

A . Sand filter

The raw water is passed through this filter which consists of some layers of cabs, different sizes of gravel and one layer of sand.

This filter removes the trace or any suspended particles in water (Herschdoerfer, 1986).

B . Carbon filter:

A carbon filter consists of a layer of gravel, sand and active carbon layer to absorb chlorine or any odor in drinking water. The filtration unit is provided by a test point which is used for detection of chlorine presence. During the filtration process the pressure of water is measured by an automatic system. The range of temperature is from 4o - 5oc^{o} , so the system occupied by a cooling system to control the level of the temperature within the required range. Now the water is ready to pass in to the filter water tank ,the sand and carbon filters are becoming less active when used for a long time. Then water can be added from the raw water unit to the filter through the clean water pipe, it can be forced upward though the filter to remove, The solids that have been collected in the filter. This process is used to clean the filter and is called ''back wash''. The sand filter is back washed daily, but the carbon filter is back washed after 48 hours (Herschdoerfer, 1986).

2.2.1.1.2.3 Reverse osmosis unit (R.O) :

This is a process that is often described as filtration, but it is far more complex than it is sometimes explained as filter because it is much easier to visualize using those terms. Reverse osmosis is just the opposite of osmosis pressure applied to water with nutrient against a certain type of membrane. As a result water comes out clean of these nutrients in this unit and the tow solutions will continue to try to reach the same level of salt in each side by the unsalted water passing through the membrane to dilute the salty water. This will continue until the head pressure created by the different concentration. R.O depends on the membrane design and the material which it is made of. The amount of total dissolved solids T.D.S reduction will range from 80%to over99%. Different minerals have different rejection rates , for instance the removal rates for that membrane is 99.5% for barium and radium 226% / 228% but only 85.5% for fluoride and 94.0% for mercury .Removal rates are dependent on head water pressure and some membranes are not tolerant to high or low pH. In this system the part of water filter unit pass through two pumps which are working in duty. When the water reaches the R.O unit, it is injected by three different chemical substances (Ali, 2005):

A . Sodium bisulphate:

This is used to complete removal of chlorine, from the water.

B . Anti scalent:

This substance consists of a phosphate compound, it is found in liquid form. Anti scalent is used for prevention of any precipitation of substances (Herschdoerfer, 1986).

C. Sulfuric acid:

This acid is used to decrease the PH. After that the water will pass through cartridge filter (capacity 80 liters) provided by nine rolls for filtrations. Then the water is passed through a high pressure pump to pump the water because this system works against osmotic force. The water pass through a membrane to reduce the salt found in water from 250 mg/dm3 to 4 mg /dm3, after passage outside of the membrane filter. Then the water passes through the other pipe carrying the mixture of product and reject water. This mixture is not good enough for providing the taste of salts which is important for taste of sugar in soft drinks. Limited amount of water will be added from the filtered water unit to the above mixture, which pass through a small cartridge filter consisting of one roll, this process is called the 'first blending'. Sometimes the amount of salts in water is not sufficient, so an amount of water from the filter water unit is added. That also passes through pump and cartridge filter to ensure that the filtration is of high quality. This process is called ''second blending'' after this stage water is tested for the presence or absence of micro organisms by ultraviolet rays. The water obtained from the R.O unit is suitable for production of different types of soft drinks and a drinking water (Herschdoerfer, 1986).

Table (1):Water impurities and its effect on beverages .

Nature of impurities	Maximum tolerance ppm	Typical effect on the beverages.
Turbidity	5	Off flavor and discoloration
Taste and odor	None	Off flavor
Algae and protozoa	None	Off flavor, growth sediment , spoilage
Yeasts	None	Off flavor, growth sediment , spoilage
Molds	None	Off flavor, growth sediment , spoilage
Iron or manganese	0,1	Staining ,discoloration ,off flavor
Alkalinity	50	Neutralizes beverage acid
Total solids	500	Chlorides, salty taste, sulfates, brackish taste

Source: SSMO (2008).

Table (2) : Water standards for barley soft drinks manufacturing.

Parameter	Limits
Taste	Un objectionable
Odor	Un objectionable
Color	Not more than 5*TCU
Turbidity	Not more than 5*TCU
Appearance	Clear
PH	6.5-8.5
***T.D.S	1000max.
Gross Alpha Activity	0.07 B a/L (maximum permissible concentration)
Gross Beta Activity	0.70 B a /L (maximum permissible concentration)
Arsenic	0.007 mg /L (maximum permissible level)
Barium	0. 5mg /L (maximum permissible level)
Boron	0.2 mg /L (maximum permissible level)
Cadmium	0.003 mg /L (maximum permissible level)
Copper	1.5 mg /L (maximum permissible level)
Cyanide	0.05 mg /L (maximum permissible level)
Fluoride	1.5 mg /L (maximum permissible level)
Lead	0.007 mg /L (maximum permissible level)
Manganese	0.5 mg /L (maximum permissible level)
Mercury	0.0007 mg /L (maximum permissible level)
Antimony	0.004 mg/L (maximum permissible level)

Source:SSMO(2008).

2.2.1.2 Carbon dioxide:

Carbonation is defined as dissolving carbon dioxide gas in water utilizing temperature and pressure, the gas is delivered to soft drinks plants in liquid form in pressurized containers (wood Roof and Philips, 1974).

Most beverages are carbonated in a range of 1.5-4.0 volumes. This is carried out with carbonated in a various designs where carbonation is speeded by providing intimate contact between the liquid and co_2 gas. The liquid is cooled because of the solubility of co_2 in the solution carbon dioxide in soft drinks acts as an important preservative against microbial spoilage. All deliveries of carbon dioxide should be odorless and a quantity of carbonated water should be prepared for sensory evaluation (Kourtis and Arvanitoyannis, 2001).

The carbonation of soft drinks has some benefits such as improving the color, consistency, taste, flavor, and overall acceptability of both fruit juice and beverages (Kaushal *et al* . , 2004) .In U.S. A, the major source of carbon dioxide is a by- product in the production of ammonia and in the refining of petroleum. In the UK the carbon dioxide is derived from, North Sea gas and also from the fermentation industries (breweries and distillers). In some countries, it is not commercially available and the soft drink manufacturers imports this essential ingredient of soft drink. Carbon dioxide is available in all three physical forms: in small quantities in form of 'dry ice', as a gas in pressurized cylinders; and in large quantities as a liquid delivered in refrigerated tankers. The last method is the most commonly used by the larger soft drinks manufacturers who can install the necessary storage tanks .When required for use the liquid carbon dioxide is converted in to the gas via a heater and pumped to the carbonator manufacturing. The carbon dioxide has been pumped by a variety of means: by washing with water; by absorbing impurities in columns of activated, molecular sieves, or activated carbon and finally by cooling and compression. Nevertheless, the occasional delivery will contain impurities, the most common is oil droplets from oil lubricated compressors not always detectable as an off odor or off taste but will cause fobbing of the soft drinks during filling. Other contaminants have been hydrogen sulfide and carbonyl sulfide. the former easily recognized by its smell but the later may only become noticeable when it is hydrolyzed to hydrogen sulfide in the soft drinks. All carbonated water made up for tasting(Kaushal *et al* . , 2004).

2.2.2.3 Sugar:

Sugar or carbohydrate, sweetener, is a principal ingredient in most soft drinks and it deserves close attention to its quality control. Sugar is derived from cane or beet and the product from either source is equally acceptable in soft drinks, it will be delivered in granulated form or as a concentrated solution in water. Granulated sugar is packed in paper or plastic packs or received in bulk; the solution is normally syrup of 66 - 67 brix. In Europe, specifications for sugar are somewhat complicated by the slightly differing standards encountered firstly in the E.C. Requires some explanation: The color type, that is the appearance of the sugar granules, is calculated by the method of the brunswick institute and one point correspond to 0.5 units, this is not an important parameter for the soft drinks manufacturer will need to specify maximum limits for heavy metals, microbiological standards and when making a clear drinks the absence of flock is more important. Suitable microbiological standards are shown in tables (3) which are taken from the standards of the national soft drinks Association of the U.S.A (Banat , 2004)

Table (3) : Sugar Standerds for Soft drinks.

	Grade	Grade	Grade	Extra white	white	Semi white
	1	2	3			
Moisture content maximum	0.06	0.06	0.06	0.10	0.10	0.10
Invert Sugar content%	0.04	0.04	0.04	0.04	0.04	0.01
Ash content%	6	15	-	6	-	-
Polarization minimum-sucrose%	99.6	99.7	99.7	99.7	97.4	99.5
Color of solution point total	4	9	6	6	12	-

Source: EC (1995).

Clarity and the absence of the color are important attributes in Sugars to be used for colorless drinks such as lemonade and tonic water . In the U.S.A the National Soft Drinks Association has quality specifications for ‘bottlers’’ granulated and liquid sugar. .The technical parameters of the specification are shown in table (4). This sugar solution will not support the growth of many microorganisms in the solid concentration at which they are delivered. Some concentrations however is liable to occur inside storage tanks and this can dilute the surface layer of the syrup , resulting in reduced concentration at which many organisms will grow. Condensation can be prevented by pumping sterile filtered air cross head space of the sugar solutions. Lengthy storage of liquid sugar is undesirable and they should normally be used within a few days of receipt. It is also imperative for liquid sugar to be delivered to the soft drink manufacturer at an acceptable temperture .Color is measured at the attenuancy in 420 n m wave lengths in a colorimeter of 50% w/w solution of the sugar. An allowance is made for any turbidity by subtracting that attenuancy in 720 nm.

$RBU_{=}1000 \times A_{420}\text{-}A_{20\div bc}$

Where

B= cell length in cm

C=concentration in g m /L

ICUMSA= international commission for uniform methods of sugar analysis

The * ICUMSA method gives the same units except that the solution is filtered through a membrane in place of reading at 720 nm.

Table (4) : Microbiological standards for sugar

Bottlers liquid sugarper10g day sugar equivalent			
Bottlers liquid sugar per10g any sample not more than	Mean of last 20 samples		95 of last 20couts
Yeast	10	10 or less	18 or less
Mesosphilic bacteria	200	100 or less	200 or less
Mould	10	10 or less	18 or less

Source: EC (1995).

2.2.2.4 Artificial sweeteners:

A number of artificial sweeteners are suitable for use in soft drinks, though they are restricted by national legislation. Some countries including the U.K; permit these sweeteners mixed with sugar in all soft drinks (Kortis and Arvanitoyannis ,2001).

Other countries restrict their use to diet drinks when acarbohydrate sweetener is present, and some countries only permit their use in drink specially labeled for diabetics. The most suitable intense sweeteners are aspartame, cyclamate and saccharin. Occasionally some of the bulk sweeteners used in soft drinks is notably sorbitol and xylitol (wood Roof and Phillips 1974).

2.2.2.5 Preservatives:

Some carbonated soft drinks notably those with a low pH can be manufactured satisfactorily without preservative . For other soft drinks particularly those containing fruit, a chemical preservative is essential unless the product can be manufactured satisfactorily without a preservative. For other soft drinks particularly those containing fruit, a chemical preservative is essential unless the product can be pasteurized. In –bottle pasteurization is not suitable for poly – ethylene tetra phthalate (PET) bottles still drinks can be pasteurized inline and then filled aseptically in to cartons. All these drinks are only preserved while the package is intact and they need to be drunk soon after opening otherwise they are liable to infection and fermentation (Nwaiwu,2006).

Alarge proportion of carbonated drinks and the concentrated drinks still require a preservative; which is usually benzoic acid, ascorbic acid or sulfur dioxide. National regulation varies as to which preservatives may be used in different types of drinks and the level of usage. All are available to a consistent and high degree of purity. And specification are published in the food chemicals codex and in the European council directive on preservatives benzoic acid issued as the soluble sodium salt or in not water and then added to sugar syrup before any addition of acid materials is made in order to avoid the less soluble benzoic acid precipitating . Sorbic acid is also used as a soluble salt and should be handled in a similar manner. In soft drinks the level of benzoic acid and sorbic acid are best determined by high performance liquid chromatography (HPLC).Sulfur dioxide can be added as sodium or potassium compound to the beverages, a solution of sulfurous acid can be used .Those materials are unstable and should be stored in air tight containers. Because of this instability the sulfur dioxide content of the materials need to be checked, and the simplest is by titration with iodine. In soft drinks the level of sulfur dioxide is best determined by distillation in to hydrogen peroxide solution and titration of the sulfuric acid so formed. Sodium benzoate (E211) , also called benzoate of soda , has the chemical formula Na $C_6H_5O_2$ it's the sodium salt of benzoic acid and exists in this form when dissolved in water , it can be produced by reacting sodium hydroxide with benzoic conditions . It is used most prevalently in acidic foods such as salad dressings (vinegar) and carbonated drinks and fruit juices(Nwaiwu,2006).

2.2.2.5.1 The mechanism of preservation:

The mechanism starts with absorption of benzoic acid into the cell. If the intracellular PH changes to 5 or lower, then aerobic fermentation of glucose through phosphor is decreased by 95% (Nwaiwu,2006).

2.2.2.5.2 Safety and health:

In combination with an a ascorbic acid (vitamin C) , (E300) sodium benzoate and potassium benzoate may form benzene which is aknown carcinogenic , heat , light and shelf life can affect the rate at which benzene is formed (Nwaiwu,2006).

2.2.2.6 Color:

In Europe food colors must comply with the specifications in the E.E.C directive on food colors while in the USA the food and drug administration not only issues specifications, but certifies every batch of color that is produced for use in food .The synthetic colors are technologically preferable because of their easy solubility in water and their stability. However, certain colors are unstable in the presence of sulfur dioxide, or tin, or when exposed to light and these factors must be taken into account when deciding which color to use in soft drink formulations .Color can be made part of the compound of base for adding to the sugar syrup; or can be added as individual items to batch of bottling syrup.In the latter case it is best to dissolve them in a small quantity of water before additions to the sugar. Solutions of color should not be kept long as they are susceptible to micro biological spoilage .In general, ahigh consistent quality is obtained from reputable color manufacturer and checks that incoming batches conform to the specifications,which need to be done occasionally (Nwaiwu,2006).

Each batch of color should simply be checked against the previous batch delivered by dissolving both samples in water in the proportion in which they are used in the finished beverage and visually comparing the solution .Caramel colors are more complex substances produced by heating sugar with reactants such as ammonia and sulfur dioxide. They are dark brown to black liquid or solids, having an odor of` burnt sugar', which is used as a flavoring (Nwaiwu,2006).

2.2.2.7 Acids:

An essential and universal constituent of soft drinks are the acid, which are part of identity of the product. The most common is citric acid, which can be obtained either anhydrous or as monohydrate, and it is found in all citrus fruits. Now citric acid is manufactured by the fermentation of sugar using species of aspergilla's. Phosphoric acid is used in the cola drinks, and more rarely malic, lactic tartaric, and acetic, acid are used. Supplies of these acids of consistent quality can be obtained from reputable manufactures, and checks on specifications need only be done occasionally. Citric, malic and tartaric acids are delivered in crystalline form and easily soluble in cold or warm water. Citric acid is also available in certain areas as concentrated solution, the handling of such solution, and of liquid phosphoric acid, needs to be done with care and attentions to safety.

Citric acid is a weak organic acid triprotic preservative also used to add an acidic or sour taste to foods and soft drinks. In biochemistry, it is important as an intermediate agent in the citric acid cycle and therefore occurs in the metabolism of almost all living things. It also serves as an environmentally benign cleaning agent and act as anti oxidant (Mohamed and Mustafe ,1978).

2.2.2.8 Malt flavor (barley):

Barley is a wonderfully versatile cereal grain with a rich nutlike flavor and an appealing chewy, pasta-like consistency. Its appearance resembles wheat berries, although it is slightly lighter in color. Sprouted barley is naturally high in maltose, a sugar that serves as the basis for both malt syrup sweeteners. When fermented, barley is used as an ingredient in beer and other alcoholic (Dosorsier *et al.***,** 2000).

2.2.2.9 Flavors:

The taste of barely soft drinks is primarily influenced by the natural or synthetic flavors used. Some soft drinks manufacturers particularly the international franchising companies manufacture their own flavor. Others obtain their flavors from the essence supply houses. These companies frequently provide flavoring compounds which only require the addition of sugar and water to prepare the bottling syrup. Specifications for these flavor compounds are obtainable from the supplies, soft drinks manufactures should be independently sampled, and test apportion of the deliveries. This ingredients of the flavor or compound are a closely guarded secret of the essence houses , but the soft drinks manufacturers should obtain warranty that all the ingredients are safe and legally permitted in the countries where the soft drinks is to be sold (Mohamed and Mustafe ,1978).

Thus most countries permit the use of natural flavoring in gradients; some prohibit the use of substances prepared synthetically or limit them to certain categories of soft drinks. For example in Germany synthetic flavoring ingredients may only be used in clear drinks. The flavor or compound may also contain solvents, anti-oxidants, emulsifiers, and clouding agents. The soft drinks manufacturers should enquire about the presence of these substances in this essences or compounds as permission to use them varies widely from country to country.

Flavors for clear drinks are usually prepared by extracting essential oils, such as citrus oils, with solvents so that when incorporated into the soft drinks them from a clear solution. Other water-soluble ingredients may be added to modify or boost the flavor, thus they are more popular drinks. The flavoring for lemonade is made by extracting lemon oil with a mixture of alcohol and water; citric may be added to boost the flavor(Mohamed and Mustafe ,1978).

The flavoring for ginger root or from the gingrine .cola flavoring is prepared with an extract of cola –nut together with a large number of other essential oils and flavoring substances. If the extractions are not carried out thoroughly the resultant flavoring will contain excessive water in soluble oils and this will show up as opalescence in the soft drink. Quality control of deliveries of flavoring should include making up a sample as the finished soft drinks and comparing it with a previous satisfactory delivery for appearance , taste and odor emulsions are used for cloudy drinks , such as orange from the whole essential oil emulsified in to water containing gum or other permitted emulsifying agent. The skill of manufacturer lies in the formulation of essential oil , water lies in the formulation of essential oil , water and emulsifier , and the machinery used to from the oil in waters emulsion, when added to the soft drink , the oil droplet from uniform cloud, which should neither settle out nor form unsightly ring cattle neck. Scientifically the essential oils have density less than water and the droplets tend to rise and weighting agents such as brominates vegetable oil, sucrose acetate iso-butyrate and serried wood rosin can be added to the oil phase, to balance the density. However, these are not permitted in many countries, including the U.K, and consequently those drinks are less stable. The quality control should include the test for measuring the opacity of the cloud in the finished drinks and some measure of its stability. The manufacture and technical control of essence and emulsions is a very skilled operation combination of science, art and high quality flavors form an integral part of first class soft drinks. The most important quality control test is a carefully comparison with a standard sample and this is best carried out by a group of members of the staff who are known to have a sensitive plate and are experienced with the soft drinks they are testing. Flavors should be stored under cool dark conditions, and can keep for over one year before any deterioration. Emulsions are less stable and may only have a life of two to four months. This should be part of the specifications agreed upon with the supplier (Dosorsier, 2000).

Table (5) : Barley soft drinks standards

Parameter	Limits
TSS	(3.8 %)
CO_2	(2.0—3.0 volume/volume bottle)
Titerable acidity%:	(0.29%)
Benzoic acid %:	100 mg/L
PH	(4.2 --- 4.7 %)
Alcohol Percentage	Without alcohol
Total bacterial count	100−200 cfu/ml
Yeasts and molds	10-18 cfu/ml18 or less
Total coliform group	-ve
Copper	0.2 mg /L (maximum permissible level)
Lead	0.02 mg /L
Iron	0.2 mg /L

Arsenium	٠.١mg /L
Stannum	٠.٠٢ mg /L

Source :SSMO(2008).

2.2.3 Manufacturing processes:

All soft drinks plants are designed to have the bottling syrup made in a separate room and pumped down to the filling line. In the case of concentrated still drinks, fruit juices, and still mineral water; the filler is simply service for getting the product into the container to a predetermined volume. In the case of carbonated soft drinks and mineral waters the filer performs a more complex operation of incorporating the carbon dioxide and mixing the syrup with a predetermined volume of water the filling line itself will consist of the following sections (Herschdoerfer, 1987):

- Filling
- Crowing , capping or seaming
- Labeling
- Packing in to crates, carton or trays with shrink wrapping .
- Loading on to pallets.

Other stages may be needed, such as a can warming device or an in line pasteurizer. Very importantly there must be inspection stations of various points along the line which are the points at which quality control is affected (Herschdoerfer, 1987).

2.2.3.1 Preparation of bottling system:

The bottling syrup contains all the ingredients of the finished product except in the case of carbonated drinks the carbon dioxide and most of the water (Kourtis and Arvanitoyannis, 2001). Sugar is the first ingredient to be added to the mixing tank; it should be as syrup and can be measured by means of a metering pump, or with a dip stick in the mixing tank .If the sugar is delivered to the factory n granulated from there is the additional process of dissolving the sugar and making syrup (Kourtis and Arvanitoyannis, 2001).

If the sugar is extremely good quality , the syrup can be made by dissolving the sugar cold water and using simple mixer. It is safety to install steam coil in the dissolving tank and bring the syrup to pasteurization temperature during solution and then cool it down using an in line heat exchanger. If the sugar is of poor quality it may be necessary to treat it with carbon , pasteurize , filter and cool (Kourtis and Arvanitoyannis, 2001).

Fruit juice , particularly canned Juices , should be inspected in a separated tank before adding to the mixing tank. The quantities of other ingredients are usually small enough to be added by hand. If necessary weighting the dry powder and dissolving in a small quantity of water before addition into the mixing tank . Flavoring compounds should be added following the direction of the supplier. All ingredients must be added carefully, taking into account their behavior in the presence of the other ingredients already added to the batch, for example sodium benzoate should be added before any acid materials, and to as great a volume of liquid as possible, to parting out of solution .Once the bottling syrup is prepared it may be necessary to filter it or pasteurize it before pumping it down to the filing line (Kourtis and Arvanitoyannis, 2001).

Each batch of bottling syrup must undergo under some control tests before being released for filling. The bare minimum is a taste test, making up the syrup as in the finished product, and measurement of the brix . The latter is hone using a hydrometer or refract meter calibrated in percent w/w sucrose (i.e. degree brix^0).Other test may be done to check to individual correct additions of minor ingredient, such as acidity. It's important to be able to test for all ingredient for which there is a legal requirement; for example, preservatives (Kourtis and Arvanitoyannis, 2001).

2.2.3.2 Packing of barely soft drinks:

To meet customer and consumer needs, soft drinks are packed in an increasing variety of containers, in the on-premise trade the traditional container for carbonated soft drinks is the returnable glass bottle with crown closure .The grocery sector, which is increasingly important in volume terms generally, provides soft drinks in lighter weight non-returnable bottles with re-usable closure, or in easy opening cans. But past few years the introduction of large PET bottles is significant trend and is dominating the market in some European countries (Kourtis and Arvanitoyannis, 2001).

2.2.3.3 Glass containers:

The returnable bottles must be given thorough cleaning and sanitizing before being refilled (woodRoof and Phillips , 1974).

Bottles are washed by soaking and flushing with caustic soda solution, followed by al thorough scrubbing inside , and out . Then they are carefully rinsed with potable water before filing. If the plant is filling one – Trip bottles or cans which will not be returned caustic washing is not necessary .These containers come from bottle and can manufacturing , companies in a sanitary wrapping , and at most needed only to be rinsed by air or water before filling.

Herschdoerfer (1987) reported that the modern Bottle washers employ a combination of soaking and jetting caustic solution up to 4.5% and temperature up to 85 Co , followed by a number of rinses.

(Dosorsier, 2000) reported that the cleaning and sterilization operation is done by a warm alkaline solution followed by rinsing with potable water .the a warm alkaline association of American Bottlers of carbonated beverages has made extensive studies of bottles washing processes . These studies have shown that the most widely recognized minimum conditions for complete and a thorough cleaning and sterilizing of bottles for this industry are as follows:

-The solution should contain 3% of total alkali of which not less than 60% is caustic soda.

-The bottles should be soaked not less than 5 minute in the sterilization and cleaning solution.

- The minimum temperature of the wash solution must be at least 54C^{o} .The standards just mentioned regarding the actual operation of bottle washing simplify the procedure greatly , the operator can be more than reasonably sure that the bottles are sterilized when they are cleaned and soaked for at least five minutes in 93% caustic salutation at a temperature not below 54C^{o} .When these conditions are constantly controlled by regular checks on the temperature, caustic content and exposure time of the bottle and adequate records on the washer are kept, the operator can be certain that a sterile bottle is produced. It is necessary to make sure that the alkali bottle washing solution is completely removed from the cleaned bottle .There are many factors that affect the bottle washing which can be determined by visual inspection , such as appearance of bottles from the stand point of clean lines and mechanical strength. There is, however the matter of improperly rinsed bottles or alkali carry over which must be checked by the phenol naphthalene test (Kaushal *et al* . , 2004).

2.2.3.4. Inspection for foreign objects:

There is perhaps no test or control in the production of soft drinks more important than inspection. Adequate and supervised inspection should be the procedure in every plant no matter how large or how small. The first inspection in a production line should be at the end of the washer. Here the operator can discard broken bottles and those that obviously cannot be washed. A careful cheek should be made to avoid feeding the Soaker with chipped necked cracked or heavily scratched bottles. Because much production delay is caused by leakers and explosions of faulty bottles, they should be caught before they enter in to the washer. Bottles should be inspected for foreign objects as they leave bottle washer. This is important before or after the syrup and carbonated water is added, because it is difficult to examine their contents, particularly in the case of dark color beverage (Kaushal *et al* . , 2004).

2.2.3.5 Filling:

One of two sequences is used in the modern filler. The bottling syrup is proportioned with treated water as predetermined ratio and the mixture is then carbonated or treated water is carbonated and then proportioned with bottling syrup under pressure. The container on the filter is pressurized with air (counter pressure) and the carbonated product can then flow gently in to the container under gravity , finally the counter pressure is released slowly enough to prevent fobbing , the container leaves the filler and goes on to be crowned , and capped or seamed (Herschdoerfer, 1987).

2.2.3.6 Crowning:

Crowning is a simplest of soft drinks manufacturing operation, crowning still requires close maintenance and quality control supervision for optimum performance. Regular maintenance and replacement of crowner throats accurate settling of crowner height, and simple gauging of crimp diameter of crowned bottles should ensure reliable sealing without excessively tight or over crimped crown (Herschdoerfer ,1987).

2.2.3.7 Sealing:

The type of closure used will determined the method of sealing. The seal may be hare to retain product liquid, and gas for long storage period under considerable pressure at ambient temperature. The specifications for the areas of contact between the bottle finish and the closure are of prime importance in producing an effective seal (Herschdoerfer, 1987).

2.2.3.8 Capping:

The application of caps is more complex procedure than crowning and the capper requires careful adjustment to ensure the thread is properly formed and a sufficient seal has been made (Herschadoeerer, 1987).

The dimensions of the closure can be checked or receipt by means of go /no-go gauges but the most important part of the quality control of these closure, is inspection of the closure application. Capped bottles should be checked for correct indentation of threads, that there are no closure or fractures in the metal, in the threaded area, and that's the caps is properly pressed on the top of the bottle so that liner from a good seal . For the customer satisfaction the cap should be removable without difficulties and the torque meter will measure the force required; and allow the soft drink manufacturer to keep it within the specific limit. The wet torque' measured shortly after the bottles are filled is a smaller force than the 'dry torque' measured after 24 h (Herschdoerfer, 1987).

2.2.3.9 Seaming:

If the product is filled cold, canning line must include a can warmer; otherwise condensation of cans will cause external corrosion also an. Essential requirement at the seamier in the canning of soft drinks is under cover gassing with carbon dioxide or nitrogen in order to reduce the air content of the head space. And prevent internal corrosion (Herschdoerer, 1987).

2.2.3.10 Labeling:

According to the Codex Aimentarius Commission (2000), the following information shall appear on the label of prepackaged foods as applicable to the food being labeled , except to the extent otherwise expressly provided in individual codex standards .The name of the food . The name should indicate the true nature of the food and normally be specific and not generic.

The country of the origin The net contents should be declared in the metric system.The list of ingredients in descending order of ingoing weight .The name and address of the manufacturer, packer, distributor,import or exporter or vendor of the food should be declared.The date of minimum durability should be declared and any special conditions for the storage of the food.Instructions for use Codex Aimentarius Commission (2000).

2.2.4 Inspection system:

In the line , system adopted will depend on a great extent on speed of the filling line, the type of container and products being filled .High speed lines filling , of returnable bottles cannot economically utilize , full manual slighting of bottles and contents .Therefore, electronic inspection devices have been developed as an essential alternative .Devices are available which sight , electronically , the complete bottle inter into the area of the bottle base only , for foreign matter and will automatically reject contaminated bottles before they reach the filling machine. This may be supplemented by a sighting operator inspecting for specific reject features, such as chipped necks or foreign bottles on slower speed units. Where electronic sighting methods are not economically justified, methods are not economically justified, visual inspection of each bottle by operator, before and after filling , is normally employed (Herchdoerfer, 1987).

2.2.4.1 PET bottles:

Bottles made of (PET) were first introduced as soft drinks containers in 1977 and now have the majority of the market in the larger, family size bottles in the U.S.A and the U.K. family size bottles in the U.S.A and the U.K. where their light weight and outbreak ability are greatly advantageous .While particular suitable for 1, 1.5, 2 and even 3 liters size ,PET bottles are now becoming a viable in 0.5 liters size . their major disadvantages are their permeability to carbon dioxide soothe product has a shorter life than it would have in a glass bottle or can .Some soft drinks manufacturers have built a PET bottles and plant next to the soft drinks plant, but the majority purchase PET bottles and have them delivered in the same way as glass bottles and cans – on delivery a sample should have it is dimensions checked, e.g. height diameter, perpendicularity, wall thickness, weight, and capacity. Special test for PET bottles are the internal pressure resistance and the top load strength. If the bottle design includes abase cup the sample should be examined for satisfactory attachment. All PET bottles should be checked for color; acetaldehyde is a common residue in the manufacturing of PET bottles. The samples should also be checked for visual defects such as deformations, scuffing, damaged base cups, and opacity due to polymer crystallization. The majority of PET bottles require roll-on enclosures' so the finish should be closely inspected (Kourtis and Arvanitoyannis 2001).

The light weight and the flexibility of PET bottles means that filling lines must be specially designed, and are different from the normal concept of a glass bottle filling line. Like new non-returnable glass bottle filling line. Like new non-returnable glass bottles, also the PET bottles must be rinsed or air blown before filing. If a rinse used hot water, detergent and caustic solution must be avoided; quality control test on the filing line must include volume and carbonation, because of the expansion of the PET , level in the bottle cannot be used as an indication of the total volume. PET is pervious to carbon dioxide and the filled product will slowly lose carbonation over storage and this becomes the deciding factor in determining the total shelf life of the product (Kourtis and Arvanitoyannis 2001).

It may be considered necessary to give the product an initial carbonation higher than would be given to the produce in glass or can partially compensate for this loss .Test should be made on the roll on closure similar to those made on the glass bottles. Samples should be taken regularly for storage plotting the carbonation loss over the stated life of the product(Kourtis and Arvanitoyannis 2001).

2.2.4.2 Outer packing:

Wood Roof and Phillip's (1994) and Dosorsier (1977) reported that once filled the containers continue along the manufacturing line and are automatically set in six-pack carries , or whatever type of retail packing is desired. Small containers are usually cartooned or cased in lost of 24 quart sizes or of 12. The case are stacked one on top of another on a wooden plat for about 4ft/sq and are then stored in a warehouse until they are loaded on to delivery trucks .Quality control of this final stage of the process should ensure that no damage in the label occurs during packing, and the final pack reaches the ultimate consumer in a clan and attractive condition (Herscoderfer, 1987).Bottles and cans are packaged in paper board boxes of various sizes according to the bottles (cans) dimensions.

The encountered hazards can be of a physical nature contributing bottle breakage and dented cans (Kouretas and Arvanitoyannis, 2000).

2.2.5 Barley soft drinks spoilage:

Spoilage rears to any undesirable change in appearance, color taste or odor taking place in beverages and may be due to physical or chemical changes in the beverages, contamination by foreign substances, or growth of microorganism. Certain physical changes may be due to heat or sun light, direct sun light is detrimental, to the flavor of almost all sever ages (Herschdoerfer, 1987).

Chemical changes that cause spoilage of beverages are oxidation, enzyme action, and reaction of free chlorine, alkalinity and minerals. Contamination by foreign odors metals or oil caused off tastes. The growth of Microorganisms in beverages may cause scums, clouds, sediments, etc. these various factors often act together making it difficult to isolate their specific effects (Herschdoerfer, 1987).

2.2.5.1 Sun light:

Beverages containing a true fruit base are much more sensitive to light than other type ; however, all beverages are sensitive to some extent . exposure to direct sunlight produce very undesirables flavor changes which , in citrus flavored beverages may often describes as only terbene like , or sour ; in most other beverages , there is merely a general loss of flavor and character, some food colors fade quickly in the sun light (Saeed and Ahmed, 1977).

Every precaution should be taken to keep beverages from the direct rays of the sun during storage in the plant, on the truck and at the sales out let. The effect of the sun light is strikingly noted after a product that has been exposed for short time has subsequently stood for a day or two prior to tasting – relation of finished beverages stock is essential for maintaining whole some beverages (Saeed and Ahmed, 1977).

Abnormally high or low temperature ranges also have a harmful effect. Freezing usual cause a change , for when the product brought to serving temperature (approximately 4C^{o}) after being frozen , precipitation and change of color sometimes take palace. There is a separation of sugar and water, and beverages needed to be remixed. High temperature (over 38C^{o}) may cause precipitation and chemical changes and will alter the flavor. Although heat generally encountered is not high enough to produce a cooked taste. However heat speeds up chemical reactions and will therefore hasten loss freshness (Herschdoerfer, 1987).

2.2.5.2 Chemical agents:

Oxygen in the air is a familiar chemical agent. Air containing oxygen is introduced into product a foreign gas, usually not intentionally and is present to some extent in all carbonated beverages. If filling and carbonating equipment is faulty, large amounts of air may introduce and the finished beverages will not have it is proper degree of carbonation. The contained oxygen may alter many flavoring material and aid in the change brought about by other chemical substances in the product. Excessive alkalinity of water, as well as high mineral content, often results in alteration of beverages produced Alkalinity is that property in water which destroys or neutralizes beverages acidity .Alkaline water used in the preparation of a beverage produce a highly insipid beverage with a decide off-Oder. That off-odor is evidently due to some reactions with flavoring ingredients. The odor gradually changes on standing (Herschdoerfer, 1987).

2.2.5.3 Organic matter:

Many times the water supply carries obvious amounts of microorganisms and biological growths or suspended materials with which the water has come in to contact. Al though the blame is often placed elsewhere, organic matter in the water supply is the cause of much of a bottler's grief, it may be present in many different arms. Protozoa and a algae may cause a separation of the flavoring oils which results in the formation of a white ring in the neck of the bottle and a change of taste on standing. The best way to completely remove organic matter room water is to super chlorinate, coagulate, filter and remove residual chlorine with activated carbon. Chlorine literally " burns up" organic matter, coagulates and gathers the particles together for quick settling and good filtration , excessive chlorine can be completely removed by activated carbon (Herschdoerfer, 1987).

2.2.6 Contamination of barely soft drinks:

Impurities in sugar definitely cause beverages to taste off-flavor and even be the cause of arranging condition in the neck of the bottle. Sugar in the soft drinks many factoring is the biggest raw ingredient, in ton age and in dollars as well as its contribution to the taste, quality and energy producing values of these products. Sugar should be stored in a dry , will ventilated and clean area and also should never be stacked directly on the floor and should be stored on a platform , allowing space for air circulation. Dust allowed accumulating on the sacks increase the chances for yeast contamination when the sugar bags are emptied in to the syrup tanks (Banat *et al.* , 2004).

2.2.6.1 Foreign odors:

It's most insidious contamination, because it's no drastic in it is action contamination with absorbed foreign doers. The off odors in the atmosphere may be caused by failure to keep the plant clan. Spoiled, soured smell is frequently associated with unclean plants (Herschdoerfer, 1987).

Plants are sometimes located in industrial centers where disagreeable order can be produced, so the right action should be taken to protect products and to be free from the sort of contaminations (Banat *et al* . , 2004).

2.2.6.2 off tastes:

The above problem appear, when the foreign odors of certain cleaning and sterilizing compounds such as paints, insecticides, and other volatile solvent are absorbed by the beverages (Banat *et al* . , 2004).

2.2.6.3 Oils:

From machinery used to manufacture the carbon dioxide gas sometimes oils find its way into the co_2 . if dry ice converters are not kept drained of oil and cleaned frequently , the oil passes in to the gas line and finally into the carbonator, filler head and eventually to the finished beverages (Herschdoerfer, 1987).

2.2.6.4 Metals:

One condition that is most detrimental to beverages flavor is metallic contamination, which has the most drastic effect on the palatability of beverages giving the beverage a metallic taste (Herschdoerfer, 1987).

2.2.6.5 Yeasts

Souring or fermentation in carbonated beverages is due to the growth of yeast identified by a winey taste and a build-up of pressure in the bottles. Yeast saccharomyces are microorganisms, that feed on sugar and heavily responsible for spoilage in carbonated beverages. They are very small, one celled plants, which are particularly fond of growing in dilute sugar solution. Yeasts are present every where they are even in the dust of the air and they may enter the yeasts are present every where they are even in the dust of the air and they may enter the product in many ways. They may enter the product in many ways. They may gain entrance into the beverage, manufacturing process by way of ingredient containers such as sugar sacks, dairy bottles or tugs, or dusty crowns, r merely through the dust in the air that is picked up during processing (Ayres *et al;* 1980).

Low acid or low carbonated beverages with no carbonation, are more susceptible to yeast growth, as acids seem to be the main inhibitor Ayres *et al;* (1980).

Yeasts growth in beverages may produce a flaky sediment soured product , loss of color, increase of Co_2 content and reduction in sugar content, the yeast actually ferment the sugar and produce carbon dioxide and alcohol. Yeasts, molds and bacterial thrive on sugar and dilute syrup, although in the very heavy syrup (Beyond 870 Br), yeast is inhibited. For this reason it is never safe to store diluted syrups be held over more them one day before bottling .As long yeast spores are deprived of moisture, they are in an unfavorable environment and remain dormant but in this stage they can readily float about in the air with dust and contaminate syrup handling equipment .When yeasts are introduced in to beverages in abnormal quantities, them these beverages will spoil. In almost every instance an a normal amount of yeasts is due to lack of cleaning and sterilization of the equipment, particularly the syrup handling equipment (tans, lines, syrups, pumps, strainers, should be build in such a manner that they can be opened easily for sanitation and cleaning (Smith and VanGrinsven 1984).

The most scrupulous sanitation practices must be maintained if yeast growth is to be controlled. If fresh water rinse tank and for inside brushes are used, be sure that, they are not contaminated. The fresh water rinse tank should be drained at the end of the day and washed out. About twice a week, make up a 25ppm chlorine solution in the tanks and leave in overnight (Ayres *et al.,* 1980).

2.2.6.6 Bacteria:

Bacterial resemble yeast in being one – celled, little plants but are very much smaller and much more widely distributed in nature .In contrast to the yeast , bacterial are very sensitive to citric acid and with every few exceptions do not grow in sugar concentration which is favorable for yeasts growth. When the bacterial grow in beverages, they usually produce a stringy mass and a flaky appearance. The beverages have upon the type of bacterial; there is usually a turbid appearance and loss of color (Ayres *et al*., 1980).

The sensitivity of bacterial to acid is responsible for the comparative rarity of bacterial spoilage in typical acidified carbonated beverages, which when encountered, is always restricted to low acid beverages. It has been found that 20 to 30 grains of citric acid per gallon of beverage is usually sufficient to eliminate bacterial spoilage. Bacteria find their way into the beverages plant in much the same manner as do yeasts , but in addition , the water , including bottle rinse water, may be also be an important source of bacterial contamination whereas yeast are rarely encountered in these sources, (Mohammed and Mustafa, 1978).

2.2.6.7 Molds:

Molds, too, find their way in to beverage plants in a manner similar to yeasts. Molds are filamentous forms, often looking like cotton when growing in masses or colonies. Individually, the cells are microscopic in size and filamentous in character; their mass growths are often observed on bread and fruits. This organism must have free oxygen or air for growth (Ayres *et al.,*1980).

When air has been even partially replaced by carbonic gas, molds are. Retarded or completely prevented from growing. They are even more tolerant to the citric acid, however, than yeast and sometimes grow in stock solutions. They love moist porous surfaces and multiply rapidly in air. Molds are fungi that require oxygen for their growth and therefore properly carbonated beverages dose not normally have enough air to support them. Molds grow quickly on the surface of strong acid solution, on stored syrup and in tanks not the roughly cleaned (Ayres *et al.* ; 1980).

2.2.6.8 Dirty bottles

Any bottle containing foreign material after the taste of the product, it's therefore necessary that, bottles be rigidly inspected and after filling. Most operators are careful in inspecting the bottles before they are fed to the soaker, this sill practically prevent objectionable bottles from going into the washer. (Herschdoerfer, 987).

2.2.7 Heavy metals content of barely soft drinks several

commercial soft drinks and respective plastic bottles were analyzed for their multi-element content. About 20 elements wore selected in the investigation samples, including some trace elements , which can be toxic for human beings, such as Ti , Cr, Sb , As and pb in soft drinks and Al, Sb, As and Pb in (PET) containers. Statically analysis was performed and similarities were verified in the multi – elements contents of the samples. On the basis of enrichment factors, the possibility of the trace elements in the PET container may be leached to the beverage under normal commercial situations (Zucchi *et al.* , 2005) . (Thanaka *et al.* ; 1996) reported that the amounts of AS and Pb in the soft drinks were less than 0.025 ppm in all samples, CD and Sn were detected in only 2 (0.006 – 0.019m)and 5 (6-9-83ppm) of 150 samples respectively. Soft drinks and other beverages as well as vegetable generally , were poor sources of zinc. (Freeland and Cousins, 1976).

In soft drinks samples, aluminum values ranged from 44.6 to 1053.3 mg/L According to the type of containers (glass or cans) statistically significant differences ($P<0.01$) were recorded (Lopez *et al.*, 2001).

2.2.8 Soft drinks shelf life:

The shelf life of Carbonated soft drinks varies, but under normal storage condition there is little evidence of deterioration up to 12 month after bottling, however , most soft drinks deteriorate rapidly if exposed to excessive sun light , strong artificial Light. The canned products have similar shelf life but PET bottles product must be dispatched and sold more quickly to avoid discernible loss of carbonation. Storage of carbonated beverage at different temperatures (ambient, 20C^{o} and 7C^{o}) shown that it could keep up to go days at ambient temperature, even during April – may when the ambient temperature reaches its maximum level. (Saeed and Ahmed ,1977).

2.2.9 Quality control and quality evaluation:

Quality control is the sum of all those controllable factors that ultimately influence positively or negatively, the quality of the finished product affected by selection of raw materials, processing methods, packing, methods of storage, and distribution conditions. Quality is defined as any of the futures that make something what it is or the degree of excellence or superiority. The word (quality) is used in various ways as applied to food. Quality product to the salesman means is of high quality and usually at an expensive nature .On the other hand the word (quality) refers to the attributes of the food which makes it agreeable to the person who consumed it (FAO,1998). This involves positive factors like color, flavor , texture and nutritive value as well as the negative characteristics such as freedom from harmful microrganisms and undesirable substances. The term control does not imply that a poor raw material can be converted in to a good finished product. In food processing the general values is that the effective methods must be carefully applied to conserve the original qualities of the raw materials .Processing cannot improve the raw materials(FAO,1998).

The aim of quality control it to achieve as good and as consistent a standard of quality in the product being produced as is compatible with the market for which the product is designed(FAO,1998).

2.2.9.1 The principles of quality control

The principles of quality control are considered under the following:

22.9.2 Raw material control:

Ware-houses often contain a large number of raw materials, such as artificial coloring, concentrate and stabilizer which may beL\8965,slowly and may deteriorate on long storage. In any product, there is a domain raw material upon which quality of finished product is mainly dependent.

2.2.9.3 Process control :

It is economically desirable to concentrate on ensuring that inspection (and rejection) at the finished product stage is reduced to a nominal level by effective raw material and process controls (FAO,1998).

2.2.9.4 Finished product inspection:

Invariably , once a soft drink product has been produced through a manufacturing process, little of finished products only permits acceptance of the material reaching the desired standard and rejection of material which fails to reach this(FAO,1998).

2.2.9.5 Raw material selection and the product quality

2.2.9.5.1 Rules of quality control:

- The dominant raw materials are selected for priority of alternation.
- The selected raw materials are tested in relation to their contribution to the product quality.
- The raw materials tested are released from the stores only after the test results.
- Process control must relate the processing results of raw materials test.
- Define the critical points in the process and concentrate on these. Finished product inspection should be reduced to the minimum level compatible with the confidence justified by the raw materials and process control. Quality control is an effective proportion to its degree of integration in to the overall organization of the factory the formation of the type of sampling and the test applied must reflect in the finished product and the test must be fast, simple and suited to the purpose. Same time reliable to enable the laboratory to give authorization to the factory to use the raw materials . This test can be chemical, physical, and bacteriological or organleptic .Careful planning is necessary for release of raw test results. The factory must not be deprivesl of an essential raw material while it awaits quality

control clearance. When there is a food cooperation management delays can be avoided. This means that the work of quality control must be integrated with factory management plan (FAO, 1998).

It is evident that the raw materials control and process control are inter – related. It is difficult to discuss raw material control without reference to process control and it is also equally difficult to talk of process control without assuming that proper raw material control is simultaneously in operation and that the dominate raw materials are known to have reached the standards required for proper processing (FAO,1998).

it is evident that the raw materials control and process control are inter – related.In planning a process control scheme, one must first and foremost list sequence, of the steps in the process and put in a flow diagram. Each step is considered critical and against it sources of deviation are prepared- from this list a number of points in the process will be recognized as critical points (CP) at which trouble may arise, which may be reflected in the quality of the finished product (NACMCF, 1997) .

The flow sheet stimulates thoughts on matters of details which might otherwise be missed and thus provides new ideas for avoiding difficulties. Against each critical point, list immediate steps which may be taken to reduce. Variation together with further ideas which could be adopted at a later stage to eliminate it completely . The success of any quality control system depends on the sympathetic interest of top management. The initiative system must come from the management. It is useless merely to instruct a laboratory to state a quality control system unless management at all levels from managing director to shop foreman is prepared to accept it and co-operate in its implementation (FAO, 1998).

Quality control is one aspect of the overall control production which its totality constitutes the management function, stock control, production management, plant maintenance and sales budgeting. All these terms used by management to describe activities directed towards achieving the purposes of the organization within the limits of its resources. The concept behind the terms used is the coordinated direction of efforts towards an idealized optimum situation in which maximum results are achieved with minimum effort. As society becomes complex, management activated may be directed not merely to achieving the maximum profile as shown in the annual accounts in any year, but to producing what might be described as a situation of profit growth. An example of this would be a decision to raise a quality standard at the expense of an immediate reduction in profit level with the anticipation that improved demand wills more than counter balance of this profit reduction in the near future (Codex Alimentarius, 2001).

It is apparent that traditional quality control is completely unable to eliminate quality problems as such a preventive strategy based on thorough analysis of prevailing conditions which provides assurance that objectives of the quality assurance programmed are met. This has been developed into the hazard analysis critical control point (HACCP) system which primary aims at guaranteeing food safety but can easily be extended to cover spoilage economic fraud. The latest quality system, such as certification under an international accepted standard (180-9000 series) and total quality management (TQM) are those in which everybody in an organization is fully committed to achieving all aspects of quality. These days' national food legislations place total responsibility for food quality on the producer (Codex Alimentarius , 2001).

2.2.10 Main elements of the HACCP system:

The main elements of the HACCP system are:

Identify potential hazard assess the risk of occurrence.

Determine the critical control. Points (CCPs) determine steps that can be controlled to eliminate or minimize the hazard.

Establish a monitoring system.

Establish procedures for verification

Establish documentation and record keeping

Hazards have been defined as the unacceptable contamination growth and survival of bacteria's in food that may affect safety or quality (spoilage) or the unacceptable production or persistence in food substances such as toxins, enzymes or products of microbiology metabolism. Simply it is a biological, chemical or physical property that may cause a food to be unsafe for consumption (ILSI, 2004) .

2.2.10.1 HACCP :

We have a HACCP system so that there is an increase in probability of right first time every time. It facilitates the ability to customers and trade across barriers.

The customer's confidence is not only increased but it shows the diligence of the manufacturer leading to constant improvement and ability to seek third party certification(codex Alimentarius , 2001).Also good series is identified and carefully chosen on the basis of risk of severity of the hazard, where severity means the seriousness of consequence when a hazard occurs and risk is an estimate of the probability of likelihood of hazard occurring (FAO , 1998).

It is only the risk which can be controlled the CCP may be allocation, procedure or processing step at which hazards can be controlled. Two types of CCP may be identified.

CCP_1 ensures full control of hazard.

CCP_2 minimizes but does not ensure full control all the CCP , and the hazards can be prevented, eliminated or reduced to acceptable levels . The CCPs should truly be critical some of the CCP are there as a result of company rules for good manufacturing practices, product regulation, and company policy (Sandrou and Arvanitoyannis , 1999). The HACCP concept sets priorities on risk and emphasizes operation that offer the greatest potential for control. Examples of CCPs are Specified head process, chilling specific sanitation procedure, prevention of cross contamination and adjustment of soft drinks to a given PH or brix^0 percentage. (NACMCF , 1997).

2.2.10.2 Criteria for target levels and tolerances for each CCP:

Adetailed description of all CCPs of necessary for effectiveness.This includes determination of criteria and specified limits or characteristics of a physical or biological nature such as time and temperature. Other known criteria such as PH and brix^0 percentage can be obtained from technical life true; however, the HACCP team needs to define the processing conditions for obtaining safe beverages (Sandrou and Arvanitoyannis , 1999).

Q1 **.Do control measure (s) exist for the identified hazard**

↑ ↓ ↓ Yes

Product ↓ No Modify step . Process or

Is control at this step necessary for safety? Yes↓

No↓ not a CCP stop

↓

Q2. Do these steps eliminate or reduce the likely occurrence of Hazard to an acceptable level?

No ↓ yes ↓

Q3. Could contamination with the identified hazard (s) occurs in excess of acceptable level (s) or could it increase to an ↓un acceptable level (s) ?↓

No → Not a CCP →Stop* Yes

Q4.will a subsequent step eliminates the identified hazard (s) or reduces its likely occurrence to an acceptable level?

↓ Yes not a CCP stop* no↓

Critical control point

Proceed to next step in described process

Figure (1) : Example of a CCP decision tree (NACMCF, 1997).

The effectiveness of control should be preferably monitored by visual observations or by physical and chemical testing. Microbiological methods are usually used to randomly verify the effectiveness of controls of all CCP s , e.g. verification of hygiene and sanitation control. Monitoring involves record keeping, data collection, and trend analysis data collection. These records are the tools which management and outside inspectors will use to ensure operations are within the specification (codex Alimentarius, 2001).

The system must allow for corrective action to be taken immediately when the monitoring resulted indicate the particular CCP is not under control and action must be taken before deviation leads to unsafely hazard .This corrective action involves four activities, and you must fix or correct the non compliance. Use the results of monitoring to adjust process to maintain control. If control is lost, you must deal with non-compliance .Maintain of the corrective actions. (codex Alimentarius , 2001) .

Quality control manager supervisors can improve the date upon which yields are calculated by using the knowledge of the properties of incoming raw material on the other hand , production control, with its detailed knowledge of movements of materials may provide information of value in improving quality control sampling methods, ..etc however , good personal relation between those concerned are essential if co-operation is to be obtained (FAO,1998).

In personal relations of the quality control department has especial responsibility. He is usually a graduate and may have enjoyed a better education than some of his colleagues. This situation some time creates mistrust or suspicion, which may be increased by an impression that the quality control staff is police force introduced by management to ensure that others are doing their job properly. In this kind of situation, it is the study of the head of the quality control section to take an initiative in breaking down barriers of mistrust and suspicion. This can neither be done overnight or by flexing one's muscles. Even if you know more than colleagues, you must avoid dogmatism and condescension .Finally quality control is a dynamic concept which evolves from initial plan as experience grow , it cans every days' production. Day to day experience of the variables to the met leads some times to simplification or original plan, the introduction of improved machinery may also affect the original plant. Year to year experience of raw materials variability can increase the degree of certainly of prediction based on raw materials testing. The bacteriological safety of pack is a factor involving the growth of confidence as experience grows (FAO , 1998).

In the industrialized world, all beverages processing is linked to the quality control. They do operate systematic quality scheme. From these consideration, it is tempting to speculate that in the twenty first century there will be a possibility of concretizing all forms of control and using modern data processing methods to obtain an integrated picture of events at any moment during the production schedule, and at the same time to provide continuous monitoring of the schedule to allow very rapid adjustment to fluctuating demand and changing circumstances. It is perhaps not too fantastic to suggest that the manager of future may sit at a desk provided with dials showing him the sales current level , the current production level , the production efficiency level , the funning profit margin and the running quality index. There seems no fundamental reason why such a system couldn't be devised to process continuous in coming information (codex Alimentarius , 2001).

Chapter Three

Chapter Three

3.Materials and Methods

3.1 Materials:

Different barley soft drinks were collected from super markets in which they were subjected to different storage conditions. Also fresh samples of the drinks were collected from four plants(A,B,C,D) producing the drink in Khartoum state .

3.2 Methods:

3.2.1 Physicochemical analysis:

3.2.1.1 Total Soluble Solids (TSS):

The total soluble solids were determined for all samples using a hand refractometer. It is expressed as (%) sucrose or degree brix^{o} according to AOAC (1980).

3.2.1.2 Gas volume:

Gas volume was determined using gas volume tester as described by Indian Standards (1974).

3.2.1.3 Determination of PH:

The PH of drink was measured with glass electrode (pH meter) (Model Hanna instrument) at ambient temperature(1974).

3.2.1.4 Determination of alcohol according to AOAC (1980).

Percentage of alcohol was estimated using alcoholmeter brand.

3.2.1.5 Determination of titerable acidity:

The titerable acidity was determined according to the method described by Ranganna (1977). Five (ml) of degassed sample was diluted with distilled water (50ml) then ten ml of diluted soft drink sample preparation was titerated using 0.1 N sodium hydroxide with phenolphthalein as indicator.

Calculation: $\text{Total acidity\%} =$

$$\frac{\text{Titre ml X N (NaOH)X volumemodoup X Equivalent weight of acid}}{\text{Volume of the sample taken X volume taken for estimationx1000}}\,x100$$

3.2.1.6 Determination of benzoic acid:

Benzoic acid was determined according to Pearson (1981). To each 20 ml of soft drink sample 20 ml of(pH $_4$) buffer solution were added, which extracted the benzoic acid by shaking with three separate portions of 25 ml of ether. Each extract washed by 4 ml of water. The combined extracts were filtered and remove the solvent. The residue was dissolved in 2 ml acetone and 2 ml water was added and titrated with 0.55 ml sodium hydroxide used phenol red as indicator. (1 ml 0.05 M Na OH = 0.0061 benzoic acid).

3.2.1.7 Potassium bromide content:

High Performance Liquid Chromatography (HPLC) was used according to AOAC (1980) .

3.2.1.8 Determination of protein*:*

Protein content was determine with Kjeldahl method according to Bradstreet (1965).

3.2.1.9 Heavy metals contents:

3.2.1.9.1 Iron , copper and Zinc:

Iron copper and zinc in soft drinks samples were estimated according to the methods described in Pearson (1981) used atomic absorption spectrometer (model 3110).

3.2.1.9.2 Lead:

Concentration of lead in soft drink was determined by using graphite furnace atomic absorption spectrometer (GFAAS) model (A.A 6800). The samples were directly without preparation in the atomic absorption spectrometer according to Pearson (1981).

3.2.2 Microbiological analysis:

3.2.2.1 Preparation of media and diluents

3.2.2.1.1 Nutrient agar

It was used for enumeration of bacteria.

It was prepared according to manufactures. Instructions by suspending 28 grams in 1L of distilled water. The medium was allowed to boiling until it was completely dissolved. The pH of the medium was adjusted 7.0 and then sterilized in autoclave at 15 Ibs pressure, (121C^o) for 15 mints.

3.2.2.1.2 Potato dextrose agar:

This medium was used for enumeration of yeast and molds. It was prepared according to manufacturer's instructions by suspending 39 grams in IL of distilled water. The medium was adjusted to 3.5 pH and then sterilized in an autoclave at 15 I bs pressure (121C^o) for 15 minutes.

3.2.2.1.3 Preparation and sterilization of glass wares:

All glass wares were soaked overnight in tap water then washed in running tap water and allowed to dry. Pipettes were plugged with cotton wood and put in canister; Petri dishes were placed in Petri dishes cans. Sterilization was done in an over at 180C^o for 60 minutes.

3.2.2.1.4 Preparation of diluents:

Diluents were prepared according to manufactures instruction by dissolving one gram of peptone tablets in IL of distilled water g and ml were transferred to each standard test tube , and covered by cotton and aluminum foil. The tubes were then sterilized by autoclave (15 Ibs , 121 C^o for 15 minutes).

3.2.2.2 Total bacterial viable count.

Total bacterial viable count was carried out using pour plate method described by (Harrigan 1998). One ml of various dilutions was poured in Petri dish's after which approximately 15 ml of the molten nutrient agar medium was added to each dish. After gentle mixing of the bacterial suspension with the medium, the agar was allowed to solidify. The plates were then incubated at 37^{o} for 48 hours. Colony counter was used to count the viable bacteria.

3.2.2.3 Total Yeasts and molds count

From a suitable dilution a sample of 0.1 ml was transferred aseptically on to solid potato dextrose agar to which 1.5 ml sterile (1:10) tartaric acid per 100 ml of medium was added to inhibit bacterial growth. The sample was spread all over the plate using a terile bent glass rod. Plates are then incubated at 25 to 28 C^{o} for 24 hours (Ban Wart 1979).

3.2.2.4 Total coliform bacteria.

Total coli form bacterial was enumerated used the pure plate count method described by (Harrigan 1998). One ml of aliquots from suitable dilution was transferred aseptically into sterile Petri dishes. To each dilution 10-15 ml of MacConky agar was added. The inoculums was mixed with the medium and allowed to solidifying. The plates were then incubated at $37C^{o}$ for 48 hours. A Colony counter was used (Quebec colony counter) for counted viable bacteria.

3.2.3 Sensory evaluation:

The carbonated beverage (barley) which was produced in four factories in the Sudan was subjected to sensory evaluation directly after production for color, appearance, taste and aroma taste by a panel of seven trained Judges, used Hedonic Scale rated (1-9) to assess the differences.

The 9 point's hedonic scales are as follows.

9- like extremely

8 – like very much

7- like moderately

6- like slightly

5- Neither like nor dislike

4- Dislike slightly

3- Dislike moderately

2- Dislike very much

1- Dislike extremely

3.2.4 Statistical analysis:

Data were subjected to Statistical Package for Social Sciences (SPSS). Means were tested using one-factor analysis of variance (ANONA), and then separated using least significant difference (LSD) test with a probability ($P \leq 0.05$) according to mead and Curnow (1983).

Chapter Four

Chapter Four

4. Results and Discussion

4.1 Quality evalution of fresh barley soft drink

4.1.1 Physicochemical characteristics :

4.1.1.1 Total Soluble Solids (TSS) :

The Total Soluble Solids (TSS) in the four plants immediately after production fresh was found to be in arange 11.31 to 11.81% Brix^o (Table6). This result was found to be within the range of 10.3 to 17.8 Brix^o,which was reported by Mohamed and Mustafa(1978). And higher than the value 3.8% Brix^o which reported by SSMO (2008).

Table (6): Total Soluble Solids (%)of barley soft drink stored under different storage conditions.

	Storage condition

drink plant	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17	11.31^{c} ±0.17
B	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22	11.41^{b} ±0.22
C	11.41^{b} ±0.60	11.41^{b} ±0.54	11.41^{b} ±0.33	11.41^{b} ±0.60	11.41^{b} ±0.54	11.41^{b} ±0.33	11.41^{b} ±0.60	11.41^{b} ±0.54	11.41^{b} ±0.33	11.41^{b} ±0.60	11.41^{b} ±0.54	11.41^{b} ±0.33
D	11.81^{a} ±0.29	11.81^{d} ±0.29	11.81^{a} ±0.29	11.81^{a} ±0.29	11.81^{d} ±0.29	11.81^{a} ±0.29	11.81^{a} ±0.29	11.81^{d} ±0.29	11.81^{a} ±0.29	11.81^{a} ±0.29	11.81^{d} ±0.29	11.81^{a} ±0.29
P-value	0.0428			0.0428			0.0428			0.0428		
$Lsd_{0.05}$	0.0093^{*}			0.0093^{*}			0.0093^{*}			0.0093^{*}		
SE±	0.0075			0.0075			0.0075			0.0075		

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT

4 .1.1.2 Co_2 volume:

The Co_2 volume in the four plants immediately after production was found to range between 3.14 - 3.95 volume in the four plants productes (Table 7). This result is within the range of that reported by Dosorsier (1977),and higher than the range of 2.0 - 3.0 reported by SSMO (2008).

Table (7): CO_2 volume of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	3.95^{a} ±0.68	3.61^{c} ±0.57	1.99^{g} ±0.26	3.95^{a} ±0.68	3.56^{c} ±0.54	1.99^{i} ±0.26	3.95^{a} ±0.68	3.51^{c} ±0.52	1.99^{h} ±0.26	3.95^{a} ±0.68	3.56^{c} ±0.54	1.99^{i} ±0.26
B	3.80^{b} ±0.64	3.61^{c} ±0.57	2.41^{e} ±0.38	3.80^{b} ±0.64	3.46^{d} ±0.50	2.38^{g} ±0.38	3.80^{b} ±0.64	3.42^{d} ±0.48	2.32^{g} ±0.38	3.80^{b} ±0.64	3.46^{d} ±0.50	2.38^{g} ±0.38
C	3.78^{b} ±0.60	3.56^{c} ±0.54	2.21^{f} ±0.33	3.78^{b} ±0.60	3.51^{c} ±0.52	2.01^{i} ±0.33	3.78^{b} ±0.60	3.41^{d} ±0.47	1.71^{j} ±0.19	3.78^{b} ±0.60	3.51^{d} ±0.52	2.01^{i} ±0.33
D	3.14^{d} ±0.47	3.06^{d} ±0.41	2.21^{f} ±0.33	3.14^{e} ±0.47	3.01^{f} ±0.39	2.21^{h} ±0.33	3.14^{e} ±0.47	2.78^{f} ±0.42	1.91^{i} ±0.23	3.14^{e} ±0.47	3.01^{f} ±0.39	2.21^{h} ±0.33
P-value	0.0468			0.0461			0.0453			0.0457		
$Lsd_{0.05}$	0.0792*			0.0747*			0.0731*			0.0729*		
SE±	0.0051			0.0049			0.0064			0.0038		

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT

4.1.1.3 Hydrogen ion concentration (pH):

The pH value of the products in the four plants immediately after production (Table 9), was found to range from 3.09 to 3.56. This value is within the range reported by Ayres *et al* . (1980) , and within the range of 2.5 to 4.03 reported by Mohamed and Mustafa (1978). These value are less than the range from 4.2 to 4.7, reported by SSMO (2008).

Table (9): pH-value of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	3.09^{cd} ±0.03	3.05^{d} ±0.02	3.00^{c} ±0.03	3.09^{d} ±0.03	3.04^{d} ±0.02	3.00^{d} ±0.03	3.09^{d} ±0.03	3.01^{e} ±0.01	3.10^{d} ±0.03	3.09^{c} ±0.03	3.04^{d} ±0.02	3.00^{c} ±0.03
B	3.56^{b} ±0.08	3.52^{a} ±0.10	3.67^{a} ±0.12	3.56^{b} ±0.08	3.52^{c} ±0.07	3.70^{a} ±0.12	3.56^{c} ±0.08	3.81^{c} ±0.07	3.91^{b} ±0.12	3.56^{b} ±0.08	3.82^{b} ±0.07	3.80^{a} ±0.12
C	3.14^{c} ±0.06	3.11^{c} ±0.04	3.11^{c} ±0.04	3.14^{d} ±0.06	3.06^{d} ±0.05	3.11^{d} ±0.04	3.14^{d} ±0.06	3.96^{a} ±0.15	3.11^{d} ±0.04	3.14^{c} ±0.06	3.06^{d} ±0.05	3.11^{c} ±0.04
D	3.11^{c}	3.01^{d}	3.01^{d}	3.11^{d}	3.06^{d}	3.01^{d}	3.11^{d}	2.91^{f}	3.01^{e}	3.11^{c}	3.06^{d}	3.01^{d}

	±0.04	±0.01	±0.01	±0.04	±0.05	±0.01	±0.04	±0.41	±0.01	±0.04	±0.05	±0.01
P-value	0.0431			0.0429			0.0425			0.0431		
$Lsd_{0.05}$	0.0428^{*}			0.0417^{*}			0.0466^{*}			0.0428^{*}		
SE±	0.0076			0.0073			0.0081			0.0076		

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT.

4.1.1.4 Alcohol:

Alcohol has been measured in barley soft drink products in the four plants (Table 11), and was found to be(0.00) , this value coincedes with SSMO (2008).

Table (11): Alcohol (%)of barley soft drink stored under different storage conditions.

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
B	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
C	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

D	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

4 .1.1.5 Titerable acidity

The titerable acidity of the products in the four plants immediately after production (Table 8) . ranged between 0.14 and 0.19% .This result was less to value (0.29%) of SSMO (2008).

Table (8): Titeratable acidity (%)of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	0.193^b ±0.05	0.197^b ±0.06	0.210^a ±0.07	0.193^b ±0.05	0.196^b ±0.06	0.210^a ±0.01	0.193^c ±0.05	0.210^b ±0.07	0.210^b ±0.07	0.193^b ±0.05	0.196^b ±0.06	0.210^a ±0.07
B	0.140^c ±0.03	0.141^c ±0.03	0.126^d ±0.01	0.140^d ±0.03	0.121^e ±0.00	0.126^e ±0.01	0.140^d ±0.03	0.121^e ±0.00	0.126^e ±0.01	0.140^c ±0.03	0.121^d ±0.01	0.126^d ±0.01
C	0.189^b ±0.04	0.191^b ±0.05	0.191^b ±0.05	0.189^c ±0.04	0.197^b ±0.06	0.191^b ±0.05	0.189^c ±0.04	0.210^b ±0.07	0.191^c ±0.05	0.189^b ±0.04	0.197^b ±0.06	0.191^b ±0.05
D	0.191^b ±0.05	0.210^a ±0.07	0.210^a ±0.07	0.191^b ±0.05	0.193^b ±0.05	0.210^a ±0.07	0.191^c ±0.05	0.240^a ±0.09	0.210^b ±0.07	0.191^b ±0.05	0.193^b ±0.05	0.210^a ±0.07

P-value	0.0473	0.0469	0.0461	0.0470
$Lsd_{0.05}$	0.0162*	0.0158*	0.0153*	0.0168*
SE±	0.0085	0.0073	0.0082	0.0074

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT.

4.1.1.6 Benzoic acid:

The concentration of the benzoic acid in the four plants immediately after production , was found to range between 0.01 and 0.07%(Table 10). This value is within the range specified by the EC (1995). Also it is less than the standard regulation (0.1%) specified by the FDA (2003) .

Table (10): Benzoic acid (%)of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00	0.072^{a} ±0.00
B	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00	0.032^{b} ±0.00
C	0.041^{b} ±0.00	0.041^{c} ±0.00	0.041^{f} ±0.00	0.041^{b} ±0.00	0.041^{c} ±0.00	0.041^{f} ±0.00	0.041^{b} ±0.00	0.041^{c} ±0.00	0.041^{f} ±0.00	0.041^{b} ±0.00	0.041^{c} ±0.00	0.041^{f} ±0.00

D	0.011^{d} ±0.00	0.011^{d} ±0.00	0.011^{f} ±0.00	0.011^{d} ±0.00	0.011^{d} ±0.00	0.011^{f} ±0.00	0.011^{d} ±0.00	0.011^{d} ±0.00	0.011^{f} ±0.00	0.011^{d} ±0.00	0.011^{d} ±0.00	0.011^{f} ±0.00
P-value			0.0485			0.0485			0.0485			0.0485
$Lsd_{0.05}$			0.0252^{*}			0.0252^{*}			0.0252^{*}			0.0252^{*}
SE±			0.0093			0.0093			0.0093			0.0093

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT.

4.1.1.7 Potassium bromide:

Potassium bromide has been measured in barley soft drink products in the four plants, and was found to be(0.00) (Table12),. This value coincedes with SSMO (2008).

Table (12): Potassium bromide content (ppm) of barley soft drink stored under different storage conditions.

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

B	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
C	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
D	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

4.1.1.8 Protein content:

Protein content immediately after productionwas found to range between 2.14 and 2.95,as shown in Table 13 the author did not trace previous finding about protein content in barley soft drink there is no previous studies for this test.

Table (13): Protein content (%)of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	2.95^{a} ±0.68	2.61^{c} ±0.57	2.50^{g} ±0.26	2.95^{a} ±0.68	2.46^{c} ±0.54	2.30^{i} ±0.26	2.95^{a} ±0.68	2.41^{c} ±0.52	1.99^{h} ±0.26	2.95^{a} ±0.68	2.46^{c} ±0.54	2.31^{i} ±0.26
B	2.80^{b} ±0.64	2.61^{c} ±0.57	2.50^{e} ±0.38	2.80^{b} ±0.64	2.46^{d} ±0.50	2.38^{g} ±0.38	2.80^{b} ±0.64	2.42^{d} ±0.48	2.32^{g} ±0.38	2.80^{b} ±0.64	2.46^{d} ±0.50	2.38^{g} ±0.38
C	2.78^{b} ±0.60	2.56^{c} ±0.54	2.21^{f} ±0.33	2.78^{b} ±0.60	2.51^{c} ±0.52	2.21^{i} ±0.33	2.78^{b} ±0.60	2.41^{d} ±0.47	1.71^{j} ±0.19	2.78^{b} ±0.60	2.51^{d} ±0.52	2.01^{i} ±0.33

D	2.14^{d} ±0.47	2.06^{d} ±0.41	2.21^{f} ±0.33	2.14^{e} ±0.47	2.40^{f} ±0.39	2.21^{h} ±0.33	2.14^{e} ±0.47	2.10^{f} ±0.42	1.91^{i} ±0.23	2.14^{e} ±0.47	2.40^{f} ±0.39	2.21^{h} ±0.33
P-value			0.0468			0.0461			0.0453			0.0457
$Lsd_{0.05}$			0.0792^{*}			0.0747^{*}			0.0731^{*}			0.0729^{*}
SE±			0.0051			0.0049			0.0064			0.0038

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT.

4.1.1.9 copper :

Copper concentration in products in the four plants immediately after production (Table 14), was found to ranged from 0.12 to 0.14ppm. These result is within the range specified by the EC (1995), and they are less than value SSMO (2008), which is 0.2 ppm

Table (14): Cu (ppm) of barley soft drink stored under different storage conditions

oft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}	0.014^{a}

	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00	±0.00
B	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00	0.012[a] ±0.00
C	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00	0.013[a] ±0.00
D	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00	0.014[a] ±0.00
P-value	0.9461			0.9461			0.9461			0.9461		
$Lsd_{0.05}$	0.00283[n.s]			0.00283[n.s]			0.00283[n.s]			0.00283[n.s]		
SE±	0.0007			0.0007			0.0007			0.0007		

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT.

4.1.1.10 Iron

Iron concentration in products in the four plants immediately after production (Table 15), was found to range from 0.03 to 0.14ppm. These results are within the range specified by the EC (1995), and this result is less than value 0.2 ppm specifications by SSMO (2008).

Table (15): Fe (ppm) of barley soft drink stored under different storage conditions

Soft	Storage condition			
	Refrigerator	Room temperature	Sunlight	Market
	Storage period (months)			

rink lant	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02	0.144^{a} ±0.02
B	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00	0.045^{b} ±0.00
C	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00	0.042^{b} ±0.00
D	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00	0.038^{bc} ±0.00
P- alue			0.05			0.05			0.05			0.05
$d_{0.05}$			0.0915*			0.0915*			0.0915*			0.0915*
SE±			0.00027			0.00027			0.00027			0.00027

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P≤0.05) according to DMRT.

4.1.1.11 Zinc :

Zinc concentration in products in the four plants immediately after production (Table 16), was found to range from 0.03 to 0.06 ppm. These results are within the range specified by the EC (1995).

Table (16): Zn (ppm) of barley soft drink stored for various periods under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04	0.069[a] ±0.04
B	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03	0.043[b] ±0.03
C	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01	0.032[c] ±0.01
D	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02	0.040[b] ±0.02
P-value	0.0499			0.0499			0.0499			0.0499		
$Lsd_{0.05}$	0.0075*			0.0075*			0.0075*			0.0075*		
SE±	0.00018			0.00018			0.00018			0.00018		

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different ($P \leq 0.05$) according to DMRT.

4.1.1.12 lead :

Lead concentration in products in the four plants immediately after production (Table 14), was found to be (0.00).These results are within the range specified by the EC (1995), and less than the value of 0.02ppm, specifications by SSMO (2008).

Table (17): Pb (ppm) of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL
B	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL
C	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL
D	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL	<DTL

4. 1. 2 Microbiological properties:

4.1.2.1 Total bacterial count:

The total bacterial count in products in the four plants immediately after production (Table 18), was found to be negligible. This value is within that reported by Mohamed and Mustafa (1978).

Table (18): Total viable count of bacteria (cfu/ml) of barley soft drink stored under different storage conditions.

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
B	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
C	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
D	Negligible	Negligible	5.OX 10^3	Negligible	Negligible	5.OX 10^3	Negligible	Negligible]	5.OX 10^3	Negligible	Negligible	5.OX 10^3

4.1.2.2 Total yeasts and molds:

Yeasts and molds in products in the four plants immediately after production (Table 19), was found to be nill. This result is different from what was found by Mohamed and Mustafa (1978), who gave a range of 45 to 850 c.f.u/ml . The result is in agreement with that reported by Ayres *et al* (1980).

Table (19): Yeasts and moulds (cfu/ml) of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
B	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
C	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
D	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

4.1.2.3 Total coliforms

Total coliforms in products in the four plants immediately after production (Table 20), was found to be nill. The result is in agreement with that reported by Mohamed and Mustafa (1978),and as the same time coincedes with SSMO(2008) specifications .

Table (20): Total coli forms (MPN/ml) of barley soft drink stored under different storage conditions.

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
B	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve
C	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

D	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

4.1.3 Sensory evaluation:

The results of sensory evaluation immediately after production (fresh) for appearance,color and taste were found to be 8 points (Tables 21,22,23,respectively) and aroma was acceptable for all panalists (Table 24).

Table (21): Appearance (scores) of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
	Scores											
A	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$5.00^b \pm 0.16$
B	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$5.00^b \pm 0.16$
C	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$5.00^b \pm 0.16$
D	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$7.00^b \pm 0.21$	$8.00^a \pm 0.28$	$8.00^a \pm 0.28$	$5.00^b \pm 0.16$
P-	0.0473			0.0473			0.0473			0.0481		

value				
$Lsd_{0.05}$	0.8195*	0.8195*	0.8195*	0.0752*
SE±	0.0062	0.0062	0.0062	0.00933

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P0.05) according to DMRT.

Table (22): Color (scores) of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
	Scores											
A	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
B	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
C	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16

D	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
P-value	0.6846			0.6846			0.6846			0.0475		
$Lsd_{0.05}$	$1.037^{n.s}$			$1.037^{n.s}$			$1.037^{n.s}$			0.0692^{*}		
SE±	0.0051			0.0051			0.0051			0.0038		

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P0.05) according to DMRT.

Table (23): Taste (scores) of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition			
	Refrigerator	Room temperature	Sunlight	Market
	Storage period (months)			

	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
												Scores
A	8.00^{a} ±0.28	7.00^{b} ±0.21	6.00^{c} ±0.19	8.00^{a} ±0.28	7.00^{b} ±0.21	6.00^{c} ±0.19	8.00^{a} ±0.28	7.00^{b} ±0.21	6.00^{c} ±0.19	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
B	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
C	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
D	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	8.00^{a} ±0.28	6.00^{b} ±0.19	5.00^{c} ±0.16
P-value			0.0462			0.0462			0.0462			0.0475
Lsd$_{0.05}$			0.0579^{*}			0.0579^{*}			0.0579^{*}			0.0692^{*}
SE±			0.0081			0.0081			0.0081			0.0038

Values are mean±SD.

Mean value(s) having different superscript(s) are significantly different (P0.05) according to DMRT.

Table (24): Aroma (scores) of barley soft drink stored under different storage conditions

Soft drink plant	Storage condition											
	Refrigerator			Room temperature			Sunlight			Market		
	Storage period (months)											
	After prod.	3	6	After prod.	3	6	After prod.	3	6	After prod.	3	6
A	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
B	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
C	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
D	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable

4.2 Quality evalution of barley soft drink under refrigeration storage

4.2.1 Physicochemical characteristics

4.2.1.1 Total Soluble Solids (TSS):

Total Soluble Solids (TSS) of the products in the four plants during the six months storage period under refrigeration (Table 6) ranged between 11.31 and 11.81 %.These results are in agreement with those reported by Saeed and Ahmed (1977) , who stated that no change in TSS % during the storage period under different conditions .Onthe ather hand this value is higher than the value 3.8% reported by SSMO (2008).

4.2.1.2 Co_2 volume :

The co_2 of the products in the four plants during the six months storage period under refrigeration (Table 7), gave a range of 1.99 to 3.61 volume, which is less than the range 2.8 to 209 volume reported by Omer (2004),while conincides with that reported by Saeed and Ahmed (1977) . However , SSMO (2008) specified a range of 2.0 - 3.0 volume .

4.2.1.3 pH:

The pH value of the products in the four plants during the six months storage period under refrigeration (Table 9), recorded arrange of 3.01 to 3.72**,** which is similar to the range reported by Ayres *et al* . (1980) , Ayres *et al*. (1980) who reported 3.7 and Omer (2004). Who found a range of 3.7 – 3.9 . these values are less than the range 4.2 to 4.7, reported by SSMO (2008).

4.2.1.4 Alcohol :

Alcohol has been measured in barley soft drink products in the four plants under different conditions (table 11), and no alcohol was detected and , this value coincedes with SSMO (2008).

4.2.1.5 Titerable acidity:

The titerable acidity of the products in the four plants during the six months storage period under refrigeration (Table 8), ranged from 0.12 to 0.20%, which is less than (0.29%) as SSMO(2008) specified .

4.2.1.6 Benzoic acid:

The concentration of benzoic acid of the products in the four plants during the six months storage period under refrigeration (Table 10), gave a range of 0.01 to 0.07%, and these values are within the range specified by the EC (1995). Also less than the standard regulation (0.1%) specified by the FDA (2003). There is no any change during storage for sixth months under different storage conditions in the for plants , Hardission *et al.* (1999) end to 98 – 262ppm ,while ISO(2004) reported 0.019 - 0.05% .

4.2.1.7 Potassium bromide :

Potassium bromide has been measured in barley soft drink products in the four plants under different conditions which was found to be nill (Table 12),, this value coincedes with SSMO (2008).

4.2.1.8 Protein content :

Protein content of the products in the four plants during the six months storage period under refrigeration (table 13), was from 2.06 to 2.61%.

4.2.1.9 Heavy metals contents: (Iron , copper ,Zinc and lead).

Iron ,copper, zinc and Lead of the products in the four plants during the six months storage period under different conditions (table 14-15-16-17) is within the range specified by the EC (1995), and less than the value of SSMO (2008).

4.2.2 Microbiological properties :

4.2.2.1 Total bacterial count:

The bacterial count of the products in the four plants during the six months storage period under refrigeration (table 18), was foud to be from (negligible to $5x10^3$ cfu/ml). This result is less than 20 cfu/ml reported by Saeed and Ahmed (1977), and within the range of 1-52 cfu/ml reported by Mohamed and Mustafa (1978). Also this result is matching with Ayres *et al* . (1980).

4.2.2.2Total yeasts and molds:

Yeasts and molds of the products in the four plants during the six months storage period under refrigeration (Table 19),are completely absent.These findings are different from what was found by Mohamed and Mustafa (1978) and Omer (2004) ,who gave arange of 15-850 cfu/ml and 0.00 to 100 cfu/ml , respectively . On the other hand these results are in agreement with that suggested by Ayres *et al*. (1980). Also, these results are in accordance with those reported by Nwawiu and Ibekwe (2006), who stated that if carbonated soft drink manufacturers keep the bottling environment yeasts free, it shows that they are in control of environment.

4.2.2.3 Total coliforms:

Total coliforms in products in the four plants under different conditions (Table 20), were found to be nill. The result is in agreement with that reported by Mohamed and Mustafa (1978), and coincedes with SSMO (2008).

4.2.3 Sensory evaluation:

The results of sensory evaluation of the products in the four plants during the six months storage period under refrigeration (tables 21-22-23-24), i.e. color; appearance and taste was found to between ranged from 8 to 6 points,and aroma was acceptable for all panalists .

4.3 Quality evalution of barley soft drink under room temperature storage.

4.3.1 Physicochemical characteristics

4.3.1.1 Total Soluble Solids (TSS):

Total Soluble Solids (TSS) of the products in the four plants during the six months storage period under room temperture (table 6) was ranged from11.31 to 11.81 brix , these values are within the range of 10.3 to17.8 brix reported by Mohamed and Mustafa (1978), but more than12.0 brix recorded by Ayres *et al* . (1980) , and 3.8brix recorded by SSMO (2008).

4.3.1.2 Co_2 volume:

Co_2 volume of the products in the four plants during the six months storage period at room temperture (Table 7) , ranged from 1.7 to 2.4 volume , they are less than the volume of 2.8 - 29 reported by Omer (2004), and they do not conform to that reported by Saeed and Ahmed (1977). However,SSMO(2008)reported 2.0 –3.0 co_2 volume.

4.3.1.3 pH:

The pH value of the products in the four plants during the six months storage period at room temperature (Table 9), was found to range from 3.01 to 3.81 .These values are similar to the value reported by Ayres *et al* .(1980), but They are less than 4.2 to 4.7, (SSMO , 2008).

4.3.1.4 Alcohol:

Alcohol has been measured in barley soft drink products in the four plants under different conditions (Table 11), and was found to be(0.00) , this value coincedes with SSMO (2008).

4.3.1.5 Titerable acidity:

The titerable acidity of the products in the four plants during the six months storage period at room temperature (Table8), ranged from 0.12 to 0.21. This finding is less than 0.29% recorded by SSMO (2008).

4.3.1.6 Benzoic acid :

The concentration of benzoic acid of the products in the four plants during the six months storage period at room temperature (Table 10), ranged from 0.02 to 0.08 . These values are below the standard regulation (0.1%) specified by the FDA (2003), and high than (0.015%) specified by the EC (1995) , who stated that the benzoic acid should not be more than 100 mg/L . these values were within the range of 98 to 262 ppm recorded by Hardission *et al* .(1999) , and less than the range of 0.019 – 0.051 % reported by ISO(2004).

4.3.1.7 Potassium bromide :

Potassium bromide has been measured in barley soft drink products in the four plants under different conditions (Table 12), and was found to be nill , this value coincedes with SSMO (2008).

4.3.1.8 Protein content :

Protein content of the products in the four plants during the six months storage period at room temperature (Table 13),was ranged from 2.01 to 2.42.

4.3.1.9 Heavy metals contents:(Iron , copper and Zinc and lead).

Iron ,copper , zinc and Lead of the products in the four plants during the six months storage period under different conditions (Table 14-15-16-17) is within the range specified by the EC (1995). and less than the value of properties SSMO (2008).

4.3.2 Microbial properties:

4.3.2.1 Total bacterial count:

Total bacterial count of the products in the four plants during the six months storage period at room temperture (Table 18), found to be in the range (negligible – 5 $x10^3$) cfu /ml. These results are more than that recorded by Saeed and Ahmed (1977). Also these results are similar to the range recorded by Mohamed and Mustafa (1978) . They agree with that suggested by Ayres *et al* . (1980) , who stated that , the microbial spoilage in bottled carbonated beverage are prevented by the combined effects of high sugar concentration , acidity , carbonation and good plant sanitation. Also these results are within the value of Sudanese standard number 526 (SSMO ,2007).

4.3.2.2 Total yeasts and molds:

The yeasts and molds in products in the four plants under different conditions (Table 20), were found to be nill.These results are different from what was found by Mohamed and Mustafa (1978) and Omer (2004), who reported 15 to 850 cfu /ml and 1.00 x104 cfu /ml, respectively. They similar to Nwawiu and Ibekwe (2006) , who stated that if carbonated soft drink manufacturer keeps the bottling environment yeast free, it shows that they are in the control of the environment.

4.3.2.3 Total coliforms:

Total coliforms in products in the four plants under different condition (Table 20), was found to be nill. The result is in agreement with that reported by Mohamed and Mustafa (1978), and coincedes with SSMO (2008).

4.3.3 Sensory evaluation:

The results of sensory evaluation in products in the four plants under different condition (Table 21-22-23-24), i.e. color; appearance and taste were foud to be range from 8 to 5 points and aroma was acceptable for all panalists .

4.4 Quality evalution of barley soft drink under direct sun light.

4.4.1 Physicochemical characteristics

4.4.1.1 Total Soluble Solids (TSS):

The brix of the products in the four plants during the six months storage period under sun light (Table 6) was ranged from 11.3 to 11.80 , these values are within the range of 10.3 to 17.8 brix reported by Mohamed and Mustafa (1978). These results are high than the value 3.8 brix (SSMO ,2008).

4.4.1.2 Co_2 volume:

The Co_2 volume of the products in the four plants during the six months storage period under sun light (Table 7) ranged from 1.7 to 3.5 . These results are not conforming to that reported by Saeed and Ahmed (1977). SSMO specifications (2008) reported arrange of 2.0-3.0 .

4.4.1.3 pH :

The pH of the products in the four plants during the six months storage period under direct sun light (Table 8) ranged from 2.9 to 3.96 ,these values are similar to 3.7 reported by Ayres *et al* . (1980) . These value are less than the range of 4.2 to 4.7,(SSMO , 2008).

4.4.1.4 Alcohol:

Alcohol has been measured in barley soft drink products in the four plants under different condition (Table 9), and was found to be(0.00) , this value coincedes with SSMO (2008).

4.4.1.5 Titerable acidity:

The titerable acidity of the products in the four plants during the six months storage period under direct sun light (Table 10) ranged from 0.12 to 0.24 .This result is less than value 0.29% (SSMO 2008).

4.4.1.6 Benzoic acid :

The concentration of benzoic acid of the products in the four plants during the six months storage period under direct sun light (table 11), ranged from 0.01 to 0.07 . These values were below the standard regulation (0.1%) specified by the FDA (2003). and higher than (0.015%) specified by the EC (1995), which stated that the benzoic acid should be not more than 100mg/L . These values are less than the range of 0.019 - 0.051% reported by ISO (2004).

4.4.1.7 Potassium bromide :

Potassium bromide has been measured in barley soft drink products in the four plants under different conditions (Table 12), and was found to be nill , this value coincedes with SSMO (2008).

4.4.1.8 Protein content :

The protein content of the products in the four plants during the six months storage period at sun light (Table 18), was found to be in the range of 1.7 to 2.42.

4.4.1.9 Heavy metals contents:(Iron , copper and Zinc and lead).

Iron ,copper , zinc and Lead of the products in the four plants during the six months storage period under different conditions (Tables 14-15-16-17) is within the range specified by the EC (1995), but less than the value of SSMO (2008).

4.4.2 Microbial analyses:

4.4.2.1 Total bacterial count:

Total bacterial count of the products in the four plants during the six months storage period under direct sun light (Table 18), was found to be in the range (negligible to 5.0 x 10^3 cfu/ml). These results are more than 20 c.f.u/ml recorded by Saeed and Ahmed (1977) . The results are within the range of that reported by Mohamed and Mustafa (1978). They are out of the limit specified by SSMO (2008) which stated that the total bacterial count should not be more than 100 cfu/ml in carbonated beverages. The results don't agree with that suggested by Ayres *et al.* (1980).

4.4.2.2 Total yeasts and molds:

The yeast and molds in products in the four plants under different conditions (Table 20), was found to be nill.These results are different from what was found by Mohamed and Mustafa (1978), and Omer

(2004).Which ranged from of 15-850 c.f.u/ml, and 0 to 100 cfu/ml, respectively. These results are in agreement with that suggested by Ayres *et al*. (1980), who stated that the addition of 0.1% of benzoate or sorbate effectively prevents the growth of yeasts and molds in syrup. Also , these results are in accordance with those reported by Nwawiu and Ibekwe (2006) .

4.4.2.3 Total coliforms

Total coliforms in products in the four plants under different conditions (Table 20), were found to be nill. The result is in agreement with that reported by Mohamed and Mustafa (1978), and coincedes with SSMO (2008).

4.4.3 Sensory evaluation:

The results of sensory evaluation in products in the four plants under direct sun light (Tables 21-22-23-24), i.e. color; appearance and taste ranged from 8 to 7 points and aroma was acceptable for all panatists.

4.5 Quality evalution of barley soft drink collected from different markets

4.5.1 Physicochemical characteristics

4.5.1.1 Total Soluble Solids (TSS):

Total Soluble Solids (TSS) of the products in the four plants of the three and six months collected from different market (table 6) was ranged from11.31 to 11.81 TSS%, these values are within the range of

10.3 to17.8 brix reported by Mohamed and Mustafa (1978), but more that 12.0 brix recorded by Ayres *et al* . (1980) . These results are higher than the value 3.8 brix (SSMO ,2008).

4.5.1.2 Co_2 volume:

Co_2 volume of the products in the four plants of the three and six months collected from different markets (Table 7), ranged from 1.7 to 2.4 volume , these values are less than the volume of 2.8 to 29 reported by Omer (2004). Also these results do not conform to that reported by Saeed and Ahmed (1977),and less than the range of 2.0 - 3.0 specified by SSMO (2008).

4.5.1.3 pH:

The pH value of the products in the four plants of the three and six months collected from different markets (Table 8), ranged from 3.01 to 3.81,these values are similar to the value reported by Ayres *et al* .(1980).Also these results are within the range of 2.5 to 4.03 reported by Mohamed and Mustafa (1978) and within the range of 3.7 to 3.9 recorded by Omer (2004). However,they are less than the range from 4.2 to 4.7, specified by SSMO (2008).

4.5.1.4 Alcohol:

Alcohol has been measured in barley soft drink products in the four plants under different condition (Table 9), and was found to be(0.00) , this value coincedes with SSMO (2008) specifications.

4.5.1.5 Titerable acidity:

The titerable acidity of the products in the four plants of the three and six months collected from different market (Table10), ranged from 0.12 to 0.21%. This result is less than value 0.29% reported by SSMO (2008).

4.5.1.6 Benzoic acid :

The concentration of benzoic acid of the products in the four plants during the three and six months collected from different markets (Table 11), ranged from 0.02 to 0.08 , these values are below the standard regulation (0.1%) specified by the FDA (2003). but higher than (0.015%) specified by the EC (1995) , who stated that the benzoic acid should be not more than 100 mg/L . These values were within the range of 98 to 262 ppm recorded by Hardission *et al* .(1999) , and less than the range of 0.019 – 0.051 % reported by ISO(2004).

4.5.1.7 Potassium bromide :

Potassium bromide has been measured in barley soft drink products in the four plants under different condition (Table 12), and was found to be nill , this value coincedes with SSMO(2008) specifications .

4.5.1.8 Protein content :

Protein content of the products in the four plants of the three and six months collected from different market (table 13), ranged from 2.01 to 2.42 .

4.5.1.9 Heavy metals contents:(Iron , copper and Zinc and lead).

Iron ,copper and zinc and Lead of the products in the four plants during the six months storage period under different conditions (Tables 14-15-16-17), is within the range specified by the EC (1995). and less than the value of SSMO (2008).

4.5.2Microbial properties:

4.5.2.1 Total bacterial count:

Total bacterial count of the products in the four plants during the third and six months collected from different markets (Table 18), found to be in the range (negligible – 5 x10^3) cfu /ml, these results are more than that recorded by Saeed and Ahmed (1977). Also these results are in similar range recorded by Mohamed and Mustafa (1978) . They agree with that suggested by Ayres *et al.* (1980) . who stated that , the microbial spoilages in bottled carbonated beverage are prevented by the combined effects of high sugar concentration , acidity , carbonation and good plant sanitation. Also these results are within the value of SSMO (2008). which specified that the total bacterial count should not be more that 100 cfu / ml (1.00x10^4 cfu /ml) in carbonated beverages.

4.5.2.2 Total yeasts and molds:

The yeasts and molds in products in the four plants under different conditions (Table 19), was found to be nill.These results are different from what was found by Mohamed and Mustafa (1978) and Omer (2004), which ranged from(15 to 850) cfu /ml and 1.00 x104 cfu /ml, respectively. Thus they are similar to Nwawiu and Ibekwe (2006) , who stated that if carbonated soft drink manufacturer keeps the bottling environment yeast free, it shows that they are in the control of the environment. Also these results indicate that the products are prepared under a good environment and quality parameters which took place on the right way.

4.5.2.3 Total coliforms:

Total coliforms in products in the four plants under different conditions (Table 20), was found to be nill. The result is in agreement with that reported by Mohamed and Mustafa (1978), and coincedes with SSMO (2008).

4.5.3 Sensory evaluation:

The results of sensory evaluation in products in the four plants collected from market (Table 21-22-23-24), i.e. color; appearance and taste was ranged between 8 to 5 points and aroma was acceptable for all panalists.

Chapter Five

Chapter Five

Conclusions and Recommendations

5.1 Conclusions:

1- The physicio-chemical properties of barley soft drinks stored under direct sun light were found to be affected negatively more than that stored at room temperature and under refrigeration.

2- Total bacterial count was found to be high during shelf – life (6 months) under direct sun light than the other conditions .

3- Yeasts and molds were not detected under all conditions.

4- it is concluded that all plants eccept one recorded similer results, while market samples showed some deterioration in sensory parameters . However , no alcohol was was found in all samples for 6 month of storge under different condition .

Finally from the results obtained in this study it can be concluded that the best storage condition for barely soft drink is refrigeration even for long times after production.

5.2 Recommendations:

1- It is necessary to work according to certain measures, precautions, and standards which lead to a good manufacturing process.

2- The products of barley soft drinks should not be exposed to direct sunlight.

3- Refrigeration storage is recommended for barley soft drinks for long time after production

4-From the results obtained in this study it can be recommanded that the production companies of soft drinks should implement a system to control the quality of the product, as part of the total quality control (TQC). Before the product leave the factory to assure a correct period of shelf – life.

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