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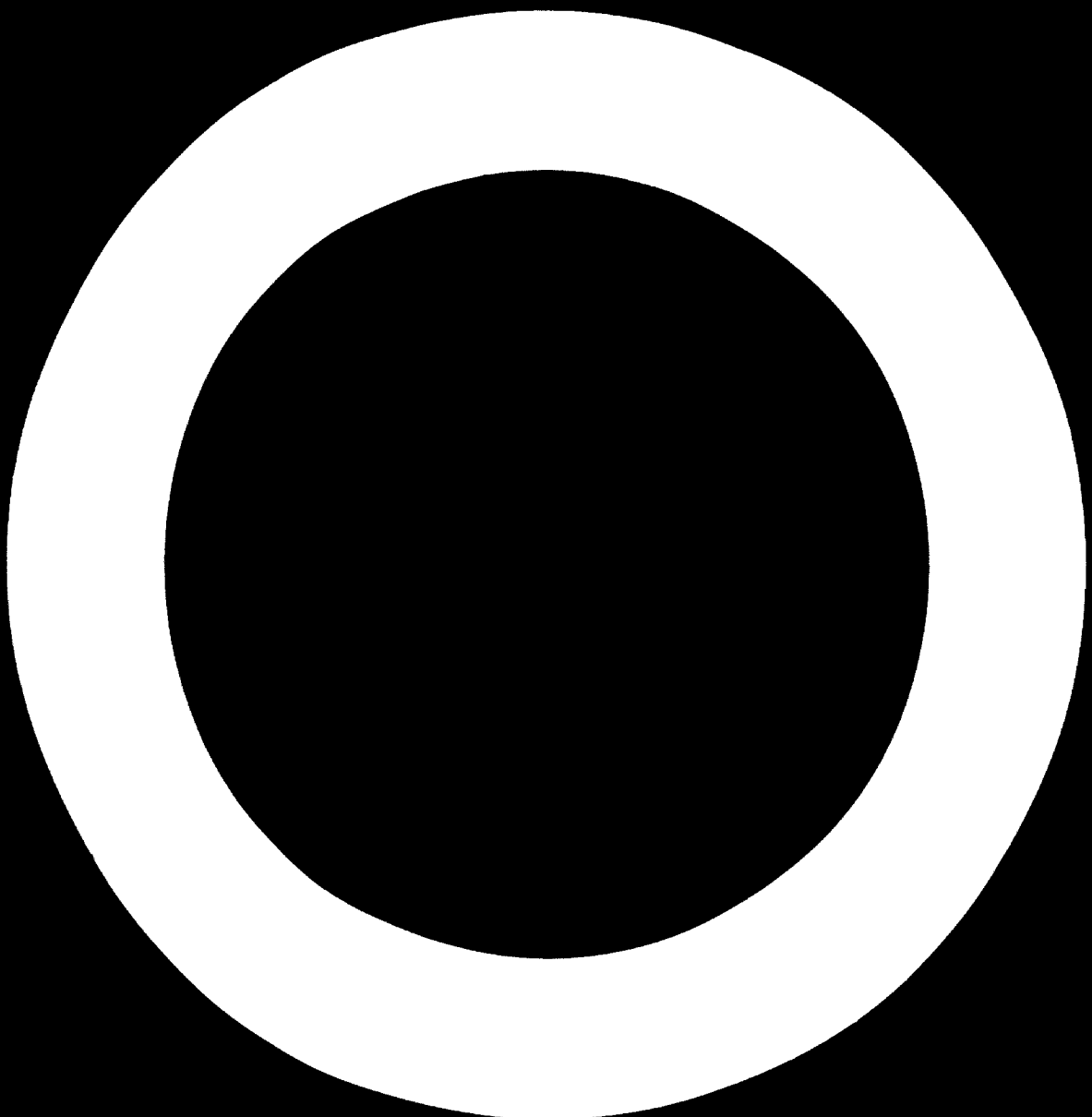
ASSISTANCE TO SOFT DRINK AND BEVERAGE INDUSTRY,

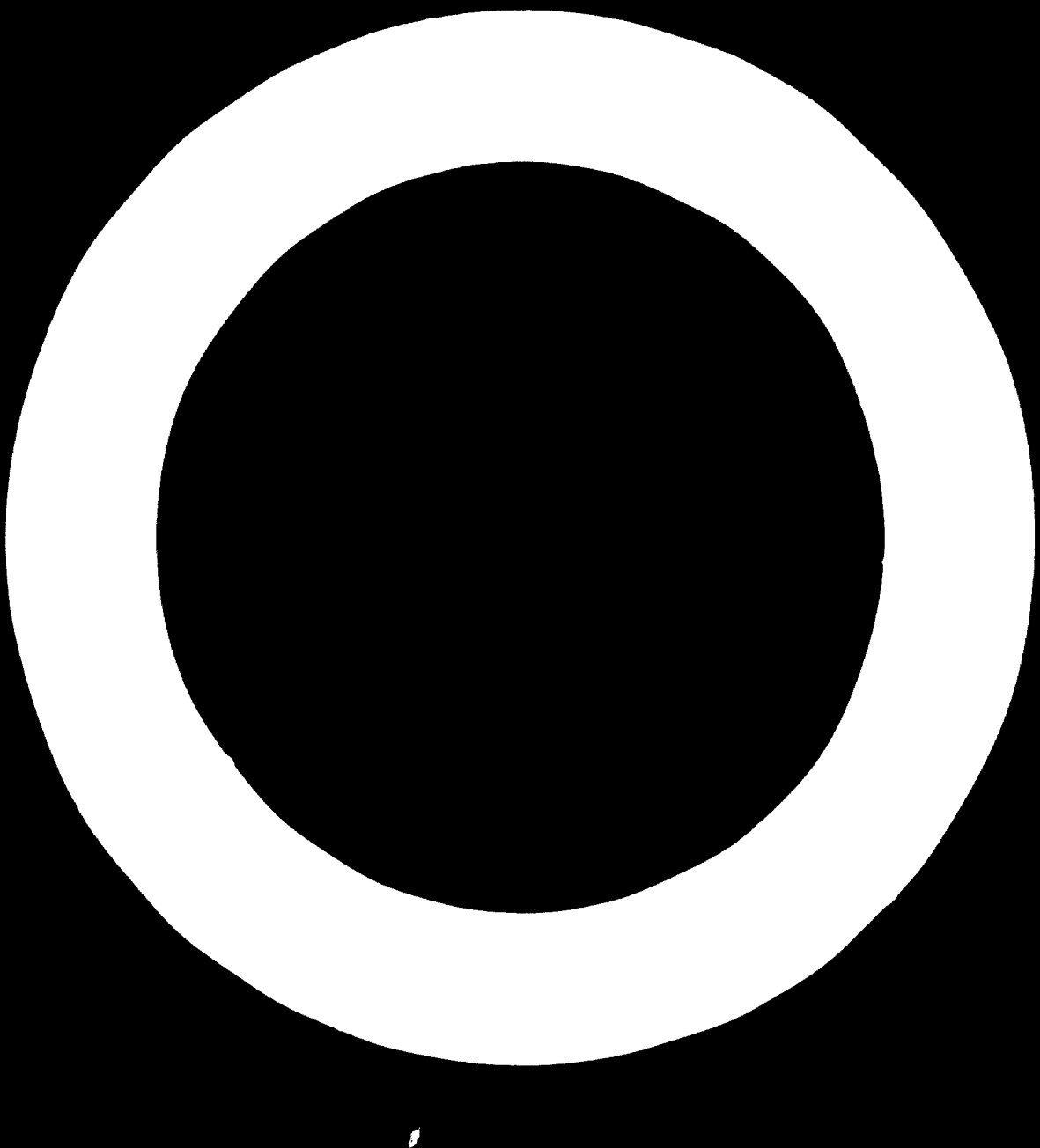
IRAQ .

TERMINAL REPORT . (1976).

Prepared for the Government of Iraq by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme

United Nations Industrial Development Organization





United Nations Development Programme

ASSISTANCE TO A SOFT DRINK AND BEVERAGE INDUSTRY

IS IRQ 73 17

IRAQ

Project findings and recommendations

Prepared for the Government of Iraq
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of P. Sauer, expert in soft drink manufacture

United Nations Industrial Development Organization
Vienna, 1976

Explanatory notes

Reference to "dollars" ($) indicates United States dollars unless otherwise stated.

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CONTENTS

Tables

SUMMARY

The project "Assistance to Soft Drink and Beverage Industry" (IS/IRQ/73/017) of the United Nations Development Programme (UNDP) in Iraq was launched on 21 October 1975 after the Cultural Affairs and Technical Assistance Department of the Ministry for Foreign Affairs requested assistance. The United Nations Industrial Development Organization (UNIDO) was executing agency, and the counterpart was the State Company for Soft Drinks.

The State Company for Soft Drinks is the main producer of soft drinks in Iraq. It consists of five plants located in Baghdad, Kirkuk, Basrah, Mosul, and Hilla which produce Pepsi-Cola, Crush-Cola, Traubi etc. It also has a small brewery in Baghdad as well as plants for the production of crowns and crates.

The original aims of the project were to make a techno-economic study on the soft drink industry including detailed analyses and recommendations on the full utilization of existing plant capacity, equipment, and manpower by the diversification of products, on new or improved products and processes and the equipment required for these.

However, the study made by the expert showed that operational problems appeared to be more urgent and accordingly, the emphasis of his work was on improving the quality and shelf life of the products and on other technical problems.

Recommendations were made to increase the shelf life of beverages and improve quality control. It was suggested that to upgrade sales in winter-time a new product be introduced, perhaps containing vitamin C to help fight colds. Further studies would have to be made before recommendations could be given on such a product.

UNDP contributed $5,000 towards this project which lasted for two months.

INTRODUCTION

An expert in the soft drink beverage industry arrived in Baghdad on 21 October 1975 to start work on the project of the United Nations Development Programme (UNDP) entitled "Assistance to Soft Drink and Beverage Industry" (IS/IRQ/73/017) in Iraq. The duration of the project was two months, and the executing agency was the United Nations Industrial Development Organization (UNIDO).

The State Company for Soft Drinks is the main producer of soft drinks in Iraq. It consists of five plants located in Baghdad, Kirkuk, Basrah, Mosul, and Hilla which produce Pepsi-Cola, Crush-Cola, Iraubi etc. It also has a small brewery in Baghdad as well as plants for the production of crowns and crates.

The Company employs about 3,000 people during the summer season (mid-April to end October) when about 14 million crates of beverages are produced. This is twice as much as is produced during the rest of the year when only some 1,800 persons are employed. The Company is therefore interested in utilizing the existing capacities and manpower the whole year round by diversifying products and introducting new ones.

The aims of the project were to make a techno-economic study on the soft drink industry including detailed analyses and recommendations on the full utilization of existing plant capacity, equipment, and manpower by the diversification of products, and on new equipment for improved products and processes.

However, the study made by the expert showed that the main problems in connexion with the efficiency of soft drink production were the quality and shelf life of beverages and the feasibility of using the plants to their full capacity during the winter season. He therefore concentrated on these problems.

The expert recommended technological methods which considerably increased the shelf life of products including the elimination of oxygen from filled bottles (which causes deterioration of the beverage) as well as sanitary treatment of equipment without dismantling it. He also tested the types of crowns used.

He made a preliminary study on the utilization of manpower and equipment and suggested a product containing vitamin C which could be sold during the winter months but this requires more study.

The expert visited the plants at Basrah and Hilla but as production lines, production methods, and sanitation methods are the same in all the plants, it was decided to do the main study at the Pepsi-Cola plant in Baghdad.

FINDINGS AND RECOMMENDATIONS

Under the climatic conditions in Iraq, it is very difficult to obtain a reasonable shelf life of the products. Conditions are good for micro-organisms to thrive and to spoil soft drinks. Because of the high temperature and sunshine, oxidation is an important problem. To ensure a satisfactory shelf life for products, it is recommended to:

(a) Remove oxygen from the head space of the bottle;

(b) Prevent fermentation by thorough sanitation;

(c) Establish a test panel for quality control of the concentrates and flavour lines.

Studies on the shelf life of Pepsi-Cola

According to the information obtained by the central laboratory of the General Company for Soft Drinks, the shelf life of their beverages, especially Pepsi-Cola, is not sufficient. After some days the beverage becomes flat and from time to time spoilage takes place by fermentation.

In order to study the flavour change, Pepsi-Cola was stored for seven days at about 28° C. After this time the taste was still acceptable, but a significant difference could be detected. Samples of Pepsi-Cola which were stored for four months without exposure to sunlight were partly spoiled by fermentation, others had a pale off-flavour and a caramel-like taste. There was no typical cola taste left.

In order to understand what influence was exerted by the oxygen in the head space of the bottle, a number of bottles of Pepsi-Cola were taken from the production line, as follows:

1. These had the usual filling level.

2. These had the usual filling level, but with a previous addition of about 100 mg ascorbic acid per bottle.

3. These were completely filled.

Bottles from categories Nos. 1, 2, and 3 were stored, as follows:

(a) Ten days at about 16° C plus six hours direct exposure to sunlight. The temperature of the beverages rose to 40° C. Under the same conditions the temperature of soda water rose to only 32° C. Results: Category No. 1 was significantly flat, less cola-like, and had a slight caramel taste; in categories Nos. 2 and 3 the flavour remained unchanged;

(b) Ten days at about 14° C. Results: Categories Nos. 1, 2, and 3 remained practically unchanged;

(c) Ten days at 17° C. Results: Categories Nos. 1, 2, and 3 remained practically unchanged.

Conclusions

The influence of air on the shelf life of beverages is deleterious. Essential oils such as those of lemon, lime etc., are easily oxidized by the oxygen in the air and their refreshing taste disappears, the beverage becomes flat, or even rancid. Besides this, air does not dissolve in liquid as well as carbon dioxide, so the air has a tendency to escape when the bottle is open. This causes the out-passing of carbon dioxide. Oxygen enables yeast cells to thrive easier, which causes spoilage by fermentation.

The oxidation of the beverage is greatly accelerated by direct exposure to sunlight, so that this problem is a serious one given the climatic conditions of this area.

Oxidation reactions are accelerated by raising the temperature. Because of its dark colour, the temperature of a cola drink rises higher by direct exposure to sunlight than a colourless drink. However, Pepsi-Cola seems to resist high temperature if oxygen is absent. After the bottles of Pepsi were heated to 58° C during the crown test, the flavour and taste remained unchanged because oxygen escaped with some carbon dioxide after shaking the bottles.

In order to ensure a satisfactory shelf life after bottling, it is important to remove oxygen from the bottle content.

Recommendations to prevent oxidation

1. The air in the head space should be removed by injecting a fine water stream. The water stream should cause "overfoaming", so that the air will be displaced. The water used should be potable and free of yeast. The jet should be located between the filler and the crowner. The jet should be connected with the filler and they should be switched on and switched off together. The diameter of the jet should be about 0.5 mm. (See figure.)

2. Air in syrup and water should be avoided.

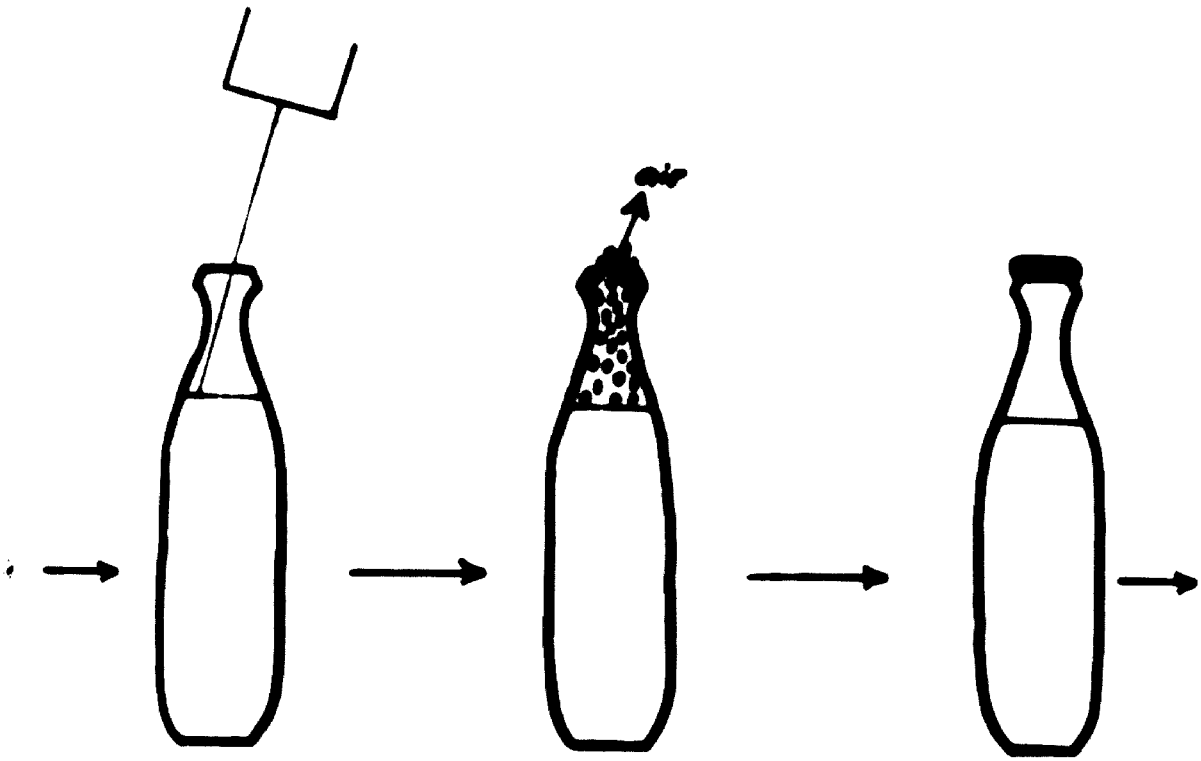


Figure. Process for removing air from head space of bottle

Crown test

A soft drink becomes flat, or even spoiled, by losing carbon dioxide. In order to test the best way to avoid such loss bottles of Pepsi-Cola were sealed using the following methods:

1. Crowns with polyvinyl chloride (PVC) compounds produced by centrifugal technique.

2. Crowns with PVC compounds produced by press technique.

3. Crowns with cork compounds and aluminium foil.

They were then put upright in a water-bath, with the crowns below water level, at a temperature of 58° C. After the beverage approximated the temperature of the water-bath, the bottles were shaken vigorously, then quickly put back into

the water-bath. Bubbles escaped at the crowns. The bottles remained in the water-bath without further heating. After 48 hours the CO_2 content was measured and the results were:

	Unheated (volumes)	Heated (volumes)
Bottles from category No. 1	3.6	3.4
		3.5
		3.4
Bottles from category No. 2	3.7	3.3
		3.4
		3.6
Bottles from category No. 3	3.7	3.5
		3.6
		3.3

Standard: 3.6 ± 0.2

The flavour and the taste remained unchanged after this treatment.

Conclusions

Though the loss of carbon dioxide was not so important, care should be taken with the crowns.

Recommendations

Each delivery should be monitored by heating and shaking closed bottles.

Spoilage by fermentation

The following are the results of microbiological tests carried out by the central laboratory on the Company's products:

1. Flavours and concentrates are free of yeast.
2. "Water side" is sanitised very well and is free of yeast.
3. Washed bottles are free of yeast.
4. Finished syrup is free of yeast.
5. Bottles of the finished beverage were taken from the same batch, some were free of, but others were contaminated with, yeast.
6. Several filling valves are contaminated with yeast.

In general, the Pepsi-Cola plant follows the sanitation programme of the Pepsi Co. International, as described in the chapter on Sanitation (11.0), Technical Services, April 1967, excepting the sanitation of the filler. According to the recommendations of Pepsi Co. International, the filler head should be lifted and the filling valves disassembled monthly, and all parts should be brushed with a general cleaning solution and with a chlorine solution. This method is time-consuming and, especially in the case of old fillers, it needs a lot of spare parts which are difficult to obtain. Therefore, on this point, it is not possible to follow the recommendations of Pepsi Co. International. However, micro-organisms flourish in the unsanitary conditions that occur when the filling valves are not properly cleaned. Under these conditions yeast cells can double every two hours and within 24 hours may increase over 4,[illegible] times.

Conclusions

In order to obtain a good shelf life, beverages must be practically free of yeast. The climatic conditions are such that at the low pH (below 3) of the beverages, yeast can thrive and spoil them.

With the exception of the filling valves, the production lines of the Pepsi-Cola plant are sanitized very well. The reason for this exception is that the filling valves are very difficult to sanitise properly within a reasonable time. In order to kill micro-organisms by disinfectant, it is necessary to bring the disinfectant in direct contact with the micro-organisms. To rinse and disinfect the whole filling valve, including the shift valve, without disassembling, is only possible by:

(a) Filling the filler bowl completely;

(b) Running a bottle under each filling valve;

(c) Filling the bottles completely until the water or disinfectant comes out of the shift valve.

Recommendations

The following method is suggested to sanitise the equipment without dismantling it.

1. Fill the filler bowl and open all valves to rinse the rest of the beverage out of the bowl.

2. Close the filling valves. Open the outlet on the cover. Fill the filler bowl with water, detergent or disinfectant until the solution runs out of the outlet in the cover.

3. Close the valve on the cover.

4. Run a bottle under each filling valve.

5. Open each valve by hand to fill the bottle completely.

6. Flush the button on the shift valve several times so that the solution used comes out from the shift valve. All shift valves should be treated in such a manner.

7. When sanitizing with chlorine, control the chlorine content of the solution running out at the shift valve (orthotolidine colour test).

The rinsing, cleaning and disinfecting procedure should include the treatment of the shift valves.

Sanitation of the critical points

If, exceptionally, it happens that it is impossible to fulfil the whole sanitation programme, it should at least be fulfilled at the critical points where the conditions for yeast cells to grow are favourable (i.e., filler, washing machine).

Quality control of concentrates and flavour bases

Concentrates and flavour bases should be examined carefully on their arrival. They may have been stored or transported at too high a temperature, or even unprotected against direct exposure to sunlight. Under such conditions the flavour as well as the taste may be changed, or even damaged. Therefore, quality control of the flavour and taste is very important in order to obtain a consistently high quality product.

Today it is possible to successfully analyse flavours by methods such as chromatography, thin-layer chromatography, and spectometry. These can help to control quality but cannot reproduce the whole sensory impression, therefore, it is not possible to replace sensory evaluation by such methods. For quality control purposes the triangle test can be recommended which gives reliable results. Three samples are submitted to the judge, one is an odd sample, two are identical. The judge has to identify the odd sample.

The following conditions are necessary to obtain reliable results from a test panel:

(a) Members with extremely sensitive palates;

(b) Trained members;

(c) Correct preparation and performance of tests;

(d) Statistical evaluation of the results.

In order to discover whether the candidate has a sensitive palate it is usual to ask him to differentiate between diluted sweet, sour, bitter, and salty solutions. The candidate should also be tested on his ability to distinguish different concentrations. Administering the triangular test is a good way to select and train candidates.

Candidates should be trained by using the products which they will later be testing. They should be trained to detect in the finished beverage the following:

(a) Too high a dosage of concentrates and flavours (5%, 10%, and 15% higher than the recipe);

(b) Too low a dosage of concentrates and flavours (5%, 10%, and 15% lower than the recipe);

(c) Rancidity;

(d) Off-flavour;

(e) Flatness.

Quality control procedure

1. Order a fresh beverage sample from the supplier by air mail. Store the sample at the temperature recommended by the supplier.

2. Take a representative sample of the delivery to be controlled. Mix the package before, if necessary.

3. Determine peroxide-number if the concentrate or flavour base contains a certain amount of essential oils. The peroxide-number of the delivery should be approximately the same as for the fresh sample. If peroxide-number is higher, oxidation of the essential oils has taken place.

4. Preparation of the beverages:

(a) Fill the bottles to be used for beverage samples with the exact amount of water required (for instance, Pepsi bottles with 250 cc). Mark the bottle at the exact fill level;

(b) Prepare the finished syrups according to the recipe with (i) the fresh sample, and (ii) the sample from the delivery. Put the exact amount into the bottle. Cool the bottles in a refrigerator to about 5° C;

(c) Water of the same quality as is used for bottling should be carbonated at the plant with about 1 to 1.5 volumes more CO_2 than is necessary in the beverage to be tested. Cool the carbonated water to about 5° C;

(d) Hold the bottle containing the exact amount of cooled finished syrup obliquely and fill it carefully with the cooled carbonated water up to the marked fill level and crown at once. CO_2 loss should not be more than 1.5 volumes.

5. Prepare a triangle test for four to eight trained judges with the fresh beverage sample and the one from the delivery. Present the different samples under the same conditions as to:

(a) CO_2 content;

(b) Temperature;

(c) Sugar content;

(d) Acidity;

(e) Amounts;

(f) Size and shape of the glasses or cups. Do not use cups with an odd taste.

Separate judges to avoid them influencing each other. In general, judges should not test after smoking, consuming spiced meals or other strongly flavoured products, or if they have a cold.

The answers of the judges should be written on a sheet of paper. If the trained judges cannot find a difference, the delivery is acceptable. If they do find a difference, a panel of 10–20 judges should be used.

6. Determine, by checking against a significance-table for triangle tests if the difference is significant. If it is, it must be assumed that the difference can be detected by the consumer.

The minimum number of correct answers to the number of judges for significant difference obtained by the triangle test are:

Judges	Minimum correct answers
8	6
10	7
12	8
14	9
16	9
18	10
20	11

Examination of quality control

In order to attain a very high measure of security, it is recommended that the quality control of the flavour and taste should be in two stages.

The first should use an expert panel which is independent of the production department, acting with scientific testing methods. In this way, it is possible to obtain reliable results on the standard concentrates and flavour bases.

The second should take place at the production line. Among the production personnel two persons for each shift with a sensitive palate should be selected. One of them should test the beverage immediately after bottling. Doing it in the simplest way, it is possible to test the beverage every hour and the tester should be well trained. The tester should act as a representative of the consumer and find out if the beverage has the standard taste to which the consumer is accustomed. Deviations should be reported to the Production Manager immediately.

Preliminary studies on the feasibility of utilisation of manpower and equipment during the winter season

The main task of soft drinks is to provide the human body with water. Because of the extremely high water demand during the summer season and the very small water demand during the winter season, the production varies as shown in Table 1.

Table 1. Total production of beverages, January and August 1974

Plant	August 1974 (cases)	January 1974 (cases)	January compared to August (percentage)
Baghdad	1,459,426	171,302	12
Kirkuk	210,987	21,416	10
Mosul	244,459	16,062	7
Hilla	178,789	16,673	9
Basrah	329,728	93,562	28

Table 2. Production in Crush-Cola plant, 1973/74
(Thousands of cases)

	Cola	Orange	Traubi	Vinni
Summer season				
September 1973	208	152	72	11
April 1974	241	94	46	13
May 1974	383	145	103	22
June 1974	472.9	167.1	149.9	20.4
July 1974	465	188	151	21
August 1974	389	182.7	126.5	15.7
	2,158.9	928.8	648.4	103.1
Winter season				
October 1973	196	77	41	2.4
November 1973	81	24	11	1
December 1973	56.3	17.3	6.4	0
January 1974	36	10.4	4.3	1.2
February 1974	55	20.9	18	1.2
March 1974	119	44	16.1	3.2
	543.3	193.6	96.8	9.0
Percentage of production during summer season	25	21	15	9

Conclusions

Table 1 shows the influence of the climate on beverage consumption.

Table 2 shows that Cola holds the highest percentage during both the winter and summer seasons.

During the winter season the consumption of soft drinks is limited. One way to raise consumption of existing products could be by giving a product a unique sales proposition (USP), for instance: in winter-time people in Iraq suffer from colds and influenza. Therefore, it would be useful to produce drinks with vitamin C, which would also give the drink a better shelf life so

- - -

[illegible] with vitamin C, a [illegible] drink which [illegible] winter season, would be attractive.

[illegible] possibility would be to introduce new products suitable for the [illegible]. However, more studies would be necessary before recommendations [illegible].

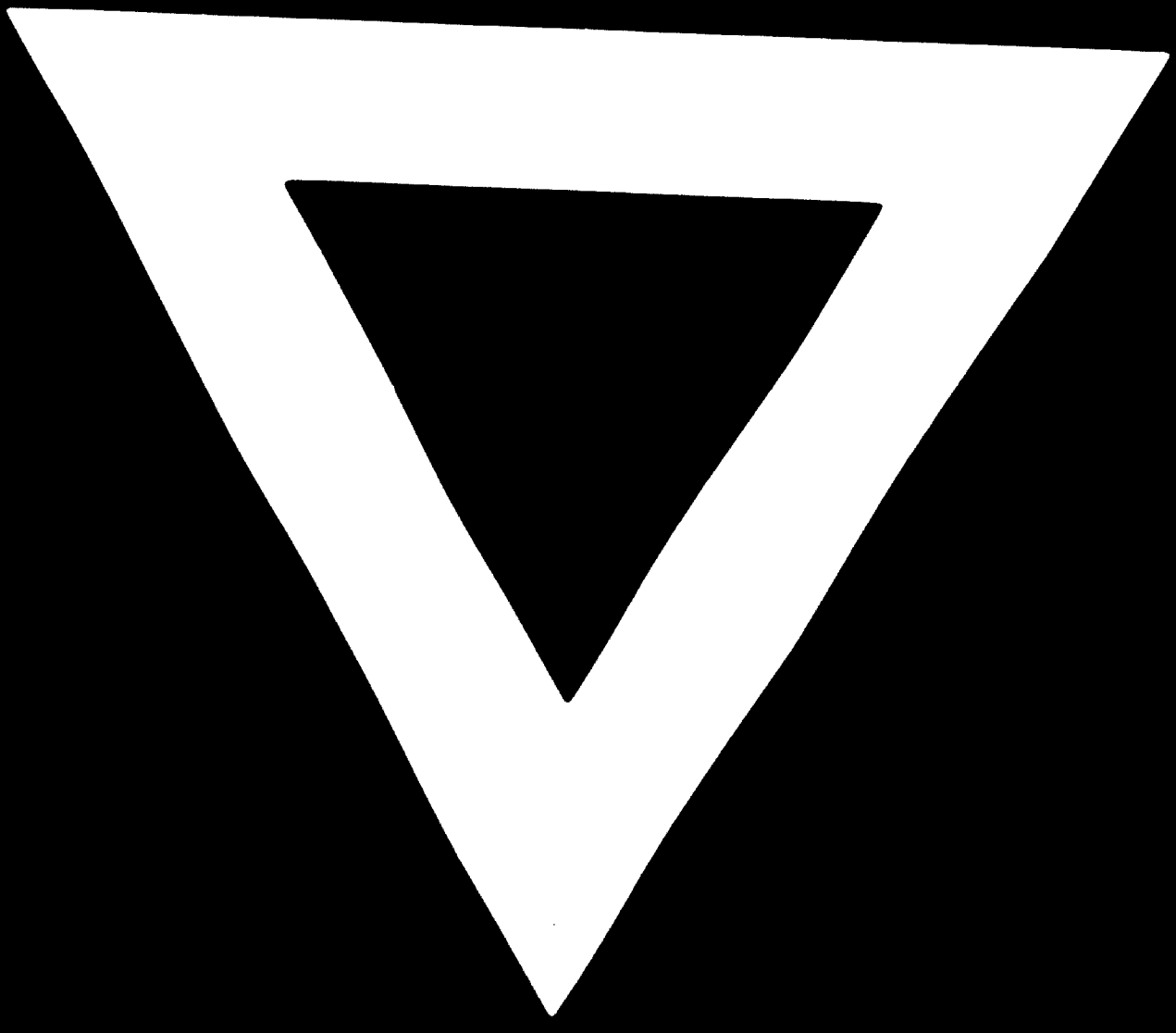
[illegible] of [illegible] and equipment

[illegible] plant, Baghdad

[illegible]	Line 1	Line 2	New line (1975)
[illegible]	3	2	2
[illegible], case washing	1	1	1
[illegible]	1	2	1
[illegible]	2	1	2
[illegible] inspection	3	2	2
[illegible]	1	1	1
[illegible] inspection	3	2	2
[illegible]	6	3	2
[illegible]	3	2	2
[illegible]	1	1	1
[illegible] treatment, syrup	1	1	2
	25	18	18
[illegible] (cases per hour)	1,000	465	750
Actual production efficiency (cases per hour	650 = 65%	350 = 75%	?
Production employees per case	25:650 = 0.038	18:350 = 0.051	?

The number of production employees per case depends mainly on the level of automation. Therefore, from the economic point of view, regular and efficient preventive maintenance is important.

With the automation level of the new line, the direct production employees per case should not be more than 0.026. Actual production output should be 90% of the capacity or more.



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