



Original Article

A study on development of new juice product comprising pears and melon

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ABSTRACT

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The study was carried out in order to achieve appropriate formulation for the development of chilled fruits juice by considering safety issues, regulation, technological aspect, costing and shelf-life investigation as well. A series of trials were conducted before achieving the final formulation of the product and amendments were carried out by reviewing the weakness and strength of the product. The study was conducted in the London South Bank University, UK. The shelf life of the product was investigated through storage trial technique after pasteurization (at 72°C) in terms of pH, color, soluble solid, sediment, taste, vitamin C and microbiological analysis for TVC (Total Viable Count) and Moulds and Yeasts count. Shelf-life investigation was carried out after 5th, 9th and 12 days. Recommended product shelf life is 10 (P+9) days without adding any preservatives and antioxidants. New juice product contains 70% Asian pear (*Pyrus pyrifolia*) juice, 20% Conference pear (*Pyrus communis*) juice, 8% melon (*Cucumis melo*) juice and 2% lime juice. 100ml of juice provides 38 kcal energy, 9g of sugar, 9g carbohydrate, 5mg sodium, 11mg calcium and 2.71mg vitamin C. Over 90% energy of this juice comes from carbohydrates. The main ingredient of this product is Asian pears and 100gm fruit contain 2.1g of dietary fibre, 5 mg of vitamin C (*Nutricalc*). The microbial load (TVC for bacteria- 145 and TVC for moulds and yeasts- 40 cfu, /100 ml juice) of this juice is highly acceptable according to IFST 1999 guideline and this product is safe for consumption with nice taste and flavor.

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Introduction

The market research for fruit juice in UK is increasing day by day and the total market value of fruit juice was £1238 million & the growth tendency continuously rising since 2003 (Mintel report, 2003). Fruits juice are showed increased sales from 2003-2008 and the sales growth remain constant over the period. In addition, the report forecast the sales growth rate of pure fruits juice for near future (Mintel report, 2003). My interest was generated towards the new product development especially fruit juice product due to the growth trend of juice market and unavailability of similar kind of product in the market. The aim of this project was to develop a juice product with the combination of pears and melon juice. Before made up my mind I met my supervisor and he suggested me to do the market survey on similar kind of products. During mini-Market survey some eminent supermarket (Waitros, Sainsbury Ltd, Tesco) has been visited in London. The extraction of Market Research and mini-Market survey made a clear view of the present juice market and there was no similar product found in the market

without containing additives. I was really serious and desperate to develop something innovative or something new that can be attractive for customers. The ingredients of this juice product are Asian pear (*Pyrus pyrifolia*), conference pear (*Pyrus communis*) and Gallia melon (*Cucumis melo*). Asian pear was used as main ingredients due to its taste, texture and yields. Asian pears are sweet and very juicy. These pears contain dietary fibre and reach in vitamin C. This pear is cheaper than tradition English pears and popular fruits in China, Japan, India and Australia. Shelf life is crucially important for the new product development and making profit for the manufacturer. The best control of enzymic browning of fruits and fruits juices are heat treatment such as blanching the whole fruits before preparing juice and pasteurization after preparation of juice. It denatures the enzyme effectively (Man, 2002). In this project, unpasteurized and pasteurized juice was investigated during shelf life determination. A series of trial was conducted in order to develop a suitable one in terms of taste, pH, soluble solid and 4th trial was

selected as final formulation for the new juice product development. The product is free from artificial additives as well as fresh and shelf – life stability is crucially important. Pasteurization is very important to make a safe product and stable shelf – life. Therefore, product was pasteurized for few minutes in a water bath to ensure the product is safe for consumption with no adverse effect. Microbiological point of view and safety concern the product was investigated before and after pasteurization by counting TVC and Moulds and Yeast according to IFST (1999) guideline for foods.

Materials and Methods

Samples collection

Asian pears, conference pears, melon and lime were purchased from local supermarket in London (Leyton Asda, white chapel, and New cross Sainsbury). Purchased fruits were brought into the Food Laboratory and kept them in the fridge at 0-4 °C.

Equipment used in the laboratory

Fruit peeler, juice exactor, ordinary sieve, blander, Saucepan, kitchen knife, water bath pasteurizer, temperature probes, pH meter, Refractometer, Blast Chiller.

Specification of Whole Asian pear

Asian pears were used as main raw materials. Specification is prepared before buying and shape, size, color, texture, flavor, moisture maturity, damage percentage and shelf life been considered.



Figure 1: Asian pear

Specification for Asian pear's juice (raw)

Physical and microbiological criteria were developed after preparation of Asian pear juice. pH, Taste, Texture, Yield, Dietary fibre, appearance, Storage condition, Shelf – life was taken into consideration during development of physical specification. Total plate count (TVC) as well as moulds and yeast were taken into consideration during development of microbial criteria of Asian pear juice.



Figure 2: Asian pear's juice

Specification of whole conference pear

Conference pears were used as raw materials. Specification is prepared before buying and shape, size, color, texture, flavor, moisture, maturity, damage percentage and self life been considered.



Figure 3: Conference pear juice

Conference pear's juice specification (Raw)

pH, Taste, Texture, Yield, Dietary fibre, appearance, Storage condition, Shelf – life were taken into consideration during development of -physical specification. Total plate count (TVC) as well as moulds and yeast were taken into consideration during development of microbial criteria of conference pear.



Figure 4: Conference pear's juice

Specification of whole Gallia Melon and melon juice

Above criteria was considered during development of specification for whole Gallia melon. Physical and microbiological criteria were developed after preparation of Gallia melon juice. pH, Taste, Texture, Yield, Dietary fibre, appearance, Storage condition, Shelf – life were taken into consideration during development of physical specification. Total plate count (TVC) as well as moulds and yeast were taken into consideration during development of microbial criteria of Gallia melon juice.



Figure 5: Gallia melon

Fruit Juices Preparation

Fruit juices were made by extracting purchased raw ingredients. After washing whole Asian pears and conference pears were blanched in boiled water due to prevent enzymic browning. Such browning makes the product undesirable to the consumers and it can limit the product shelf life. Concentration of active phenolase and phenolic compounds, the pH, the temperature and the available oxygen of the tissue are most important factors that determine the rate of enzymic browning (Martinez & Whitaker, 1995). After blanching both pears were peeled, cut into halves and removed the seeds. The juice was extracted by squeezing fruits with the juice extractor & sieved. 750ml of juice was collected from 1kg 300g of Asian pears and 400ml of juice was collected 1kg of conference pears. The yield of Asian pear juice was 57.7 % and conference pear juice was 40%.

Melon juice preparation

A whole melon was weighed and the whole melon was 750g. Washed the melon manually with clean tap water. Peeled the melon and removed the seeds and other debris. After wards, the melon was cut into small pieces and 300 ml of juice was collected after squeezing the melon through a juice extractor. The juice was sieved and the yield of melon was 40%



Figure 6: Melon juice

Lime juice preparation

Lime juice was squeezed immediate before the formulation of proposed juice according to the recipe.

Formulation of proposed juice

A series of trial was conducted in order to develop the final formulation in terms of taste, pH and soluble solid. In terms of taste, pH and soluble solid the 4th trial was satisfactory and 4th one was selected as final formulation. 4th trial was tested as other three in accordance with taste, pH and soluble solid.

Table 1. Formulation of juice

Name of the ingredients	The amount of each ingredients(ml)	The percentage of each ingredients
Asian pear juice	700 ml	70 %
Conference pear juice	200 ml	20 %
Melon juice	80 ml	8 %
Lime juice	20 ml	2 %
Total	1000 ml	100%

Filtering of Juice

Naturally, the juice is cloudy and cloudy juices are available in the market. Some customers like cloudy juice and some are not. But the aim of this project was to develop a semi cloudy juice. The juice was filtered through ordinary and vacuum filter and medium to slow filter papers were used.



Figure 7. Different types of filtered and unfiltered juice

Pasteurization of juice

The purpose of this heat treatment is to destroy moulds, yeasts and bacteria that can cause fermentation, spoilage and unsafe for human consumption. To ensure the safety and quality of product the pasteurization equipment has to be under reliable control.

In this project the juice was bottled in sterile glass bottle and placed them in a hot water bath which was heated at 72°C. The bottles were held in the hot water and as soon as the product reached at 72 °C start counting the given amount of time that was 15 minutes. That's mean the newly developed juice was pasteurized at 72 °C for 15 minutes. During samples pasteurization, time and temperature were recorded manually. A temperature probe was placed in one of the bottles to monitor the temperature of the juice. In large scale production it would be used as a test bottle per batch, to monitor the temperature and to ensure that the correct temperature was reached. Afterwards pasteurized juice was cooled down at 4°C.

Shelf-life investigation

Three litres of juice was prepared and poured 100 ml of juice into 250ml sterile glass bottle. 18 samples were made and samples bottle were labeled with 5, 9 and 12 days sticker. Shelf life investigation was conducted between fresh unpasteurized; pasteurized unfiltered and pasteurized filtered samples. All samples were stored in the fridge at 4°C (± 1 °C) during shelf life investigation. The following data were recorded for unpasteurized, pasteurized unfiltered and filtered pasteurized samples immediately after the preparation and pasteurization. pH, Soluble solid (%Brix), color, Taste and microbial load for Unpasteurized sample(A)

3.8, 13.4, pink, sweet, 2.025×10^5 c.f.u's (Colony Forming Units) per ml and Moulds& yeasts- 7.4×10^3 c.f.u's per ml. For Pasteurized unfiltered sample (B) were 4, 13.6, slight pink, sweet, PCA- 50 cfu, per ml and moulds and yeasts- 30×10^3 c.f.u's per ml. For pasteurized filtered sample (C) were found 4, 12.8, watery, sweet, TVC- 30 c.f.u's per ml and moulds and yeasts- 50 cfu, per ml.

The following qualities were monitored in the juice samples during shelf life investigation

pH measurement

pH of 15- 20 ml samples were determined at room temperature and by using a pH-meter. It was expressed as the negative logarithm of the hydrogen ion concentration in a solution. pH was determined for three different samples i.e. after 5 days, 9 days, and 12 days.

Total soluble solids (% Brix)

The Brix was determined by measurement of the refraction index with a Refractometer at certain temperature. The Brix of samples were observed at 20 °C after 5 days. Again after 9 days and 12 days samples were observed at 21 and 23°C respectively. Refractometer reading were recorded and expressed as percentage.

Color observation

Color of the juice was determined by naked eyes comparing with the pantone color chart. The color of 5 days, 9 days and 12 days samples were measured during storage trials. The color changes developed juice should be measured comparing with the colorimetric parameters (reflectance spectra, color difference and CIELAB) during shelf life investigation. But in this project, the colorimetric parameters were not observed due to the time limitation and after filtering the juice was not clear enough. Although one reading was taken by using spectroscopy but the result was not satisfactory

Taste

During the shelf life investigation all samples were tasted. The triangle difference test was conducted to make the difference between two samples. It is the most popular difference test among four (British standard online 5929). The taster panel consisted of 12 participants age between 18-49 apart from the vulnerable group (all members were MSc students and studying Food Science in London South Bank University). The panel lists were asked to differentiate one sample among others in accordance with the taste, color, appearance and flavor

Sediment

In this project, it was observed the colloidal particles i.e., amount of sediment precipitated in the bottom of the glass bottle was observed and measured by ordinary scale comparing between the samples (unpasteurized, pasteurized unfiltered and pasteurized filtered).

Titrimetric analysis of vitamin C using DCPIP

During the shelf life investigation samples on the day of production, after 9 days and 12 days samples were determined.

Aerobic plate counts (TVC, Moulds and yeasts)

Microbiological analysis was carried out on the samples at regular interval during shelf life investigation. Pour plate

technique was used to analyze the microbial counts. Before doing the microbial analysis the media such as plate count agar, malt extract agar and peptone water were prepared.

Sensory Analysis

Both developed juice product and commercial juice were tasted using Triangular Test by taste panel and panel consisted of 12 tasters. Half of the participants were students from London South Bank University and rest of them was MacDonald's employee. MacDonald's employees are known to me and they were participated without bias. However, the result was analyzed and the 10 tasters out of 12 able to make the difference between the samples. The participants put their opinion in a form of questionnaire.

Perform nutritional labelling by using food for PC and Nutricalc Software

Nutritional labelling were performed for the new juice product by using *food for PC and it is kind of nutritional software* located in the Food lab at the London South University.

Result and Discussion

pH Measurement

During shelf life investigation, pH of unpasteurized, pasteurized unfiltered and pasteurized filtered samples on 5th day was 4, 4.1 and 4.2. Those samples on 9th day found 4.1, 4.1 & 4.3. Finally i.e., after 12 days found 4.1, 4.1, 4.

Total soluble solid

Soluble solid of all samples was determined within the time interval during storage. It was found that the percent Brix was not changed significantly. Soluble solid ranges were 12.7- 13.4.

Taste

During shelf life determination all samples were just tasted. All 5 and 9 days samples were tasted and the result was positive i.e. sweet. 5 and 9 days unpasteurized sample was tasted and the result was not satisfactory due to smelly odor and less sweetness. After 12 days, Pasteurized unfiltered and filtered samples were tasted and the perception of taste wasn't similar as 5 and 9 days pasteurized samples.

Color observation

Color of the samples was measured comparing with the pantone color chart. After 9 days the color of the unpasteurized sample was started deteriorating and after 12 days sample got dark pink color. Pasteurized and unfiltered samples were almost remained unchanged. But after 12 days the sample got bit pink color comparing with 9 days sample. During observation, it was tried to distinguish color changes during shelf life investigation.

Blanching of whole fruits and pasteurization after preparation was used as most effective processing steps to halt browning.

Sediment

The sediment was observed at the bottom of sample's bottle and it was found due to the precipitation of colloidal particles. The sediment was measured with an ordinary scale. Sediment was found in both unpasteurized unfiltered and pasteurized unfiltered samples. The sediment was not visible in pasteurized filtered samples. 0.1 cm of precipitation or

sediment was found in other two samples during shelf life investigation.

Aerobic plate count

After 5, 9 and 12 days the result of microbial counts indicated that the number of c.f.u's of bacteria, moulds and yeasts per ml of unpasteurized unfiltered juices (AI=5 days, AII=9days and AIII= 12 days) were significantly increased during storage. Pasteurized unfiltered (BI, BII) and pasteurized filtered (CI, CII) samples were investigated after 5 and 9 days and the result showed that no. of colonies for both samples were not exceeded the target level. Simultaneously, 12 days pasteurized unfiltered (BIII=12 days sample) sample was investigated and the result was not satisfactory but the no. of colonies of bacteria, moulds and yeasts were not exceeded the maximum level. Sample CIII showed the satisfactory result and target level was not exceeded.

Result of microbial analysis

5 days samples (AI= Unpasteurized unfiltered, BI= pasteurized unfiltered, CI= pasteurized filtered.) 9 days samples (AII= Unpasteurized unfiltered, BII= pasteurized unfiltered, CII= pasteurized filtered.) 12 days samples (AIII= Unpasteurized unfiltered, BIII= pasteurized unfiltered, CIII= pasteurized filtered.)

Average result found after 5 days for Aerobic Plate Count (PCA @ 30°C for 48 hours) and Yeasts and Moulds count (MA @ 25°C for 72 hours) for AI samples were 6.4×10^5 cfu/ml & 2.27×10^4 cfu/ml respectively. Simultaneously, found in BI samples were 130 cfu/ml & 40 cfu/ml and found in CI Samples were 60 cfu/ml & 30 cfu/ml.

Again, Average result found after 9 days for Aerobic Plate Count (PCA @ 30°C for 48 hours) and Yeasts and Moulds count (MA @ 25°C for 72 hours) for AII samples were 2.46433×10^6 cfu(Colony Forming Unit)/ml & 3.8×10^3 cfu/ml respectively. Simultaneously, found in BII samples were 145 cfu/ml & 40 cfu/ml and found in CII Samples were 80 cfu/ml & 30 cfu/ml.

Finally average result found after 12 days for Aerobic Plate Count (PCA @ 30°C for 48 hours) and Yeasts and Moulds count (MA @ 25°C for 72 hours) for AIII samples were 1.28×10^7 cfu/ml & $> 10^6$ cfu/ml respectively. Simultaneously, found in BIII samples were 3.44×10^4 cfu/ml & 2.995×10^4 cfu/ml and found in CIII Samples were 85 cfu/ml & 40 cfu/ml.

Vitamin C analysis

Vitamin C was analyzed to determine the amount of vitamin C during shelf life investigation in order to see the deviation in different samples (unpasteurized and pasteurized samples on the day of preparation and after 9 days and 12 days for both samples during storage). 4.22 mg of L ascorbic acid i.e. vitamin C found in unpasteurized juice and after pasteurization on the same day 3.54 mg of vitamin C was found per 100 cm³ of juice on the day of production. During storage similar samples were analyzed after 9 days and 12 days. The amount of Vitamin C was found 3.9, 3.12 and 2.76, 2.71 mg respectively.

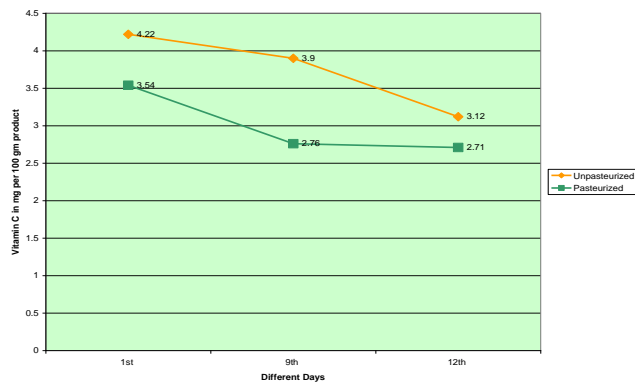


Figure 8: Trend of vitamin C loss during the storage period

Bench marking of the new product

Developed juice product is completely new and the existing products are not similar as this product according to market survey. Consequently, it was very difficult to do the product bench marking with existing one. The existing products contain 100% pear juice with additives ascorbic acid which is mentioned in the labelling. However, two bottles of long life pear juice (Company name Clive's farm) was bought from Waitros and added 100ml of Gallia melon juice into 900ml of commercial pear juice. This idea was given by my supervisor to resolve this problem. Though new pears and melon juice contains 90% of pear juice without adding any additives or preservatives. After adding melon juice with commercial sample, the product pH and soluble solid was measured comparing with the new product. Physical and organoleptic taste for developed new product were pH-4.1, soluble solid-13.3, taste-sweet and color- pink. Clives fruit farm (commercial sample), pH - 3.3, 3.4 (after adding melon), soluble solid-15.3 Taste-sour (sharp) and color was light orange.

Result of sensory analysis

The null hypothesis is that it is not possible to distinguish between the samples. In this case the probability P of identifying the sample which is different from other two is equal to P_0 . In statistical terms, the null hypothesis H_0 is expressed by $P_0 = 1/3$. However, in this case, the correct number of replies (10 out of 12 assessors) is checked against British Standard statistical table and the number of correct replies was greater than the statistical table. This is corresponding that a proportion of correct replies significantly higher than $P_0 = 1/3$ at the 5 % significance level.

Nutritional labelling

Nutritional labelling was performed for per 100 ml of new juice product by using *food for PC software* at the London South University. According to nutritional labelling, 100ml of juice provides 38 kcal energy, 9g of sugar; 9g carbohydrate, 5mg sodium, 11mg calcium and 2.71mg vitamin C and Nutricalc software were used for determining nutritional value for Asian pear.

Conclusion

Actually, manufacturer and retailer profit entirely depend on product shelf life. In this project, the product shelf life was investigated by storage trial technique and the product was evaluated through quality and microbiological examination. Achieved data was analyzed in order to determine the

product shelf life in terms of taste, color, pH and microbiological load and it was found that the pasteurized unfiltered sample showed the better result after 9 days comparing with others two. In accordance with quality and safety parameter, developed juice product's pH was 4.1, Soluble solid (% Brix) was 13.3, Vitamin C was 2.76 mg/100ml, sweet in taste, slightly pink and microbial load-TVC (Bacteria) was found 145 cfu_s and TVC (Moulds and Yeast) 40 cfu_s were found.

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