DETERMINATION OF ANTIOXIDANT AND ACIDITY REGULATORS AS ADDITIVES IN DIFFERENT FRUIT JUICES OF INDIA

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The increasing demand for ready-to-drink juices has led to challenges for food distributors regarding the safety and quality of their foods hence food additives are added to foods to keep them fresh, control its pH and improve the flavor, texture, color or taste and appearance. The present work aimed at the quantitative determination of additives as ascorbic acid and citric acid in a variety of fruit juices of India using the classical titration method, to check whether the current uses of these additives are according to the Food Safety and Standard Authority of India (FSSAI). Consuming too much amount of vitamin C may increase the amount of oxalate in your kidneys, which has the potential to lead to kidney stone problem. The high intake of citric acid leads to stomach pain, diarrhea, nausea or vomiting, increased sweating and fast heart rate. In this study, we have selected 14 different popular juice samples which are consumed most by Indian children. Each sample was analyzed for organoleptic or physical tests such as color, texture, flavor, taste and pH. These findings indicated that the current use of ascorbic acid and citric acid in all juices by the fruit juice industry is below the permitted limit of FSSAI and are safe for the consumption by Indian children.

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Introduction

Nowadays most people tend to eat the ready-made food available in the market rather than preparing it at home. Such foods contain some additives and preservatives so that their quality and flavor are maintained and bacteria and yeasts do not spoil them. Current trends show that increasing technology and inclusion of packaged foods in the diets of modern society leads to an increase in the use and need of food additives.

The USFDA defines food additives as "any substance, the intended use of which results or may reasonably be expected to result directly or indirectly if it is becoming a component or otherwise affecting the characteristics of any food".[1]

Direct additives are those that are added intentionally to food for a specific purpose, while indirect additives are those to which the food is exposed during processing, packaging or storing.[2] Food additives are substances which are added to food which improve the flavor, texture, color, taste, appearance, function as processing aid or are chemical preservatives. Food additives as non-nutritive substances added intentionally to food, generally in small quantities to improve its appearance, flavor, texture or storage property.[3,4]

Food safety is a global problem and a large number of consumers worldwide face a variety of food safety risks each year. The majority of food safety incidents are caused by illegal activities, especially by abuse of food additives and even illegal use of chemical additives. The synthetic food additives react to the cellular component of the body leading to the various physiological effects. Many effects like food allergies, food intolerance, cancer, attention deficit hyperactivity disorder (ADHD), brain damage, nausea, cardiac disease among others have been reported.[5] Additive has been used for many years to preserve, flavor, blend, thicken and color foods and have played an important and essential role in reducing serious nutritional deficiencies.[6] There are thousands of food additives found in food. USFDA maintains a list of over 3000 ingredients in its food additive database.[7] Additives may cause different allergies, asthma, high fever, and certain reactions such as rashes, vomiting, headache, and tight chest.[6] The use of food additives in food manufacturing has been a public health issue for many years.[8]

The increasing demand for ready-to-drink juices has led to challenges for food distributors regarding the safety and quality of their foods. Acidity regulators are used to changing or otherwise control alkalinity and acidity of foods. Acidity regulators or pH control agents are the food additives added to improve or maintain the pH of the food. They can be organic acids or mineral acids, bases, neutralizing agents or buffering agents. Acidity regulators are used to altering and controlling the acidity or alkalinity at a specific level important for processing, taste and food safety.

Citric acid is a weak organic acid. It is a white crystalline powder extracted from citrus fruits. It has a distinct sour taste. The molecular weight of citric acid is 192.09. The molecular formula is $C_6H_8O_7$. The E number of citric acid is E330. The citric acid has many uses, including food preservatives. It has a pleasant citrus flavor that works well in beverages and juices and crunchy snacks. Citric acid is used both as a natural flavor enhancer and preservative in a variety of foods such as jams, jellies, canned fruits and vegetables, ice creams, fruit drinks, candies and carbonated drinks and beverages. It helps to regulate acidity, is an antioxidant and maintains the pH of the food. Many canned food contains added citric acid because it helps to extend the shelf life of the product as well as enhance the flavor.

The most common adverse symptom of high intake of citric acid includes stomach pain, diarrhea, nausea or vomiting, loss of appetite, and increased sweating, fast heart rate, restless feeling, and slow breathing. The uncommon symptoms are cloudy urine, fever, headache and increase in blood pressure. Sometimes pain in muscles also occurs.

The oxidation process spoils most food, especially those with high-fat contents. Antioxidants are the food additives which increase the shelf life of foods by inhibiting oxidation. Some of the antioxidants foods additives combine with oxygen to prevent oxidation and others prevent the oxygen from reacting with the food leading to its spoilage. In the absence of antioxidant food additives, oxidation of unsaturated fats takes place, rendering a foul smell and discoloration of food. Oxidation is a chemical reaction that can produce free radicals leading to chain reactions that may damage cells. Antioxidant terminates these chain reactions. Fats turn rancid when exposed to oxygen.

Ascorbic acid is also commonly known as Vitamin C. Its E number is 300. It acts as an antioxidant. It is used in many foods as an anti-oxidizing agent. The molecular weight of vitamin C is 176.12. The chemical formula of vitamin C is $C_6H_8O_6$.

There are many juices and fruit drinks available in the market which contains added Vitamin C. There are many benefits of using antioxidant food additives. If we read the ingredient list for fruit juices and drinks, cereals, fruit-flavored candies, cured meats, cereals and frozen fruits, ascorbic acid is added. An antioxidant is a molecule that inhibits the oxidation of other molecules. Antioxidants prevent or inhibit the oxidation process. The most common antioxidant additives are ascorbic acid i.e., vitamin C. □

The most common side effect of high vitamin C intake is digestive distress and kidney stones. If it is taken in very high doses, it exhibits common side effects including headache, feeling faint, redness and warm feeling of the skin or flushing, nausea, vomiting or diarrhea, heartburn, and abdominal cramps. The most common side effect of high vitamin C intake is digestive distress and kidney stones. Consuming too much amount of vitamin C may increase the amount of oxalate in your kidneys, which may lead to kidney stone problem. The recommended daily intake of vitamin C is 90 mg for men and 75 mg for women.[9]

Experimental

General

The chemicals used for analysis were of A.R. Grade and were from S.D. fine chemicals. They were used without further purification. All the experimental vessels and storage containers were Pyrex glass.

In this research work, each sample was analyzed for organoleptic or physical tests such as color, texture, flavor, taste and pH measurement.

Qualitative analyses of different juice were done for additives content such as acidity regulator as citric acid and antioxidant as ascorbic acid. The 14 different packaged fruit juices were selected, which are most popular among the children of India, from the local market of Aurangabad, India. They were then frozen in plastic bags in household freezer (-20 °C) and kept until analysis. The packaged fruit juice samples, as shown in Table 1, were selected. All these juices are made in India.

Table 1. Packaged fruit juice samples selected for analysis from the Indian market

Code	Indian Brand Name	Type of Fruit Juice
A	Appy	Apple juice
B	Frooti	Mango juice
C	Real fruit power	Mix fruit juice
D	Tropicana Mixed Fruit	Mix fruit juice
E	B-Natural Orange	orange juice
F	Minute Made Apple	Apple juice
G	Maaza Refresh	Mango juice
H	Alo Fruit Berries	Berry juice
I	Enerzol Orange	Orange drink
J	Tropicana Pineapple	pineapple juice
K	Paper Boat Alphaso Aam	Mango juice
L	Delmonte Pineapple	Pineapple Juice
M	Pride Pinch Lemon	Carbonate Lemon
N	Fruit Valley Mix	Mix fruit juice

Determination of pH

Exactly 25 mL of liquid sample was weighed and transferred to a 100 mL dry beaker. It was dissolved in a small amount of boiled and cooled distilled water by little warming. The volume was made to 100 mL by using decarbonized distilled water. The pH of this solution was recorded on a pH meter at room temperature.

Determination of acidity regulator as citric acid (E330)

Accurately weighed about 2 g sample was mixed in 50 mL decarbonized distilled water, warmed for about 15-20 min and cooled to room temperature. In the case of dilute samples, 10 mL of sample solution was mixed with is 20 mL of distilled water. The solution was titrated against 0.1 N sodium hydroxide solution using phenolphthalein solution as an indicator.

Determination of acidity regulator as acetic acid (E260)

About 10 mL of the sample was taken in a conical flask and 20 mL of distilled water was added in it. It was boiled for about 5 min, cooled to room temperature and was titrated against the 0.1 N NaOH solution using phenolphthalein as an indicator.

Determination of antioxidant as ascorbic acid (E330)

Accurately about 10 mL of the sample was taken in a conical flask and 25 mL of dilute H_2SO_4 was added in it. This solution is titrated with the 0.1 N iodine solution using starch as an indicator.

Results

The experimental results of the determination of additives in the selected fruit juices are depicted in the Tables 2-4.

Table 2. Physical/organoleptic tests of packaged fruit juices

Code	Colour	Flavor	Taste
A	Light brown	Apple	Sweet
B	Light yellow	Mango	Sweet
C	Light red	Mix fruit	Sweet
D	Light orange	Mix fruit	Sweet
E	Light orange	Orange	Sweet and sour
F	Light brown	Apple	Sweet
G	Dark yellow	Mango	Sweet
H	Light violet	Berry	Sweet and sour
I	Orange	Orange	Sweet and sour
J	Light yellow	Pineapple	Sour
K	Dark yellow	Mango	Sweet
L	Light yellow	Pineapple	Sweet
M	Colorless	Lemon	Sour
N	Light brown	Mix fruit	Sweet

Table 3. Determination of pH and ascorbic acid as an antioxidant in packaged fruit juices

Code	pH	Ascorbic acid %	Code	pH	Ascorbic acid %
A	5.60	1.58	H	6.2	3.34
B	3.64	1.32	I	3.30	2.46
C	5.16	2.46	J	3.80	2.90
D	5.47	2.81	K	5.90	1.84
E	3.60	3.34	L	4.25	2.70
F	5.50	1.58	M	2.35	1.58
G	5.80	1.60	N	4.19	2.46

Table 4. Determination of citric acid as an acidity regulator in packaged fruit juices.

Code	Citric acid, %	Code	Citric acid, %
A	3.26	H	3.07
B	3.64	I	2.49
C	2.68	J	4.73
D	4.41	K	2.75
E	5.21	L	3.71
F	3.52	M	4.80
G	2.49	N	2.43

Discussion

All the Juice samples were selected for the qualitative analysis of additives present in it. Each juice samples was analyzed for pH, antioxidant as ascorbic acid and acidity regulator as citric acid. The pH of juices changes along a wide scale, the highest pH, 6.20 is of Alo berries juice and the lowest pH, 2.35, is of pride pinch lemon. The values for each sample can be seen in Table 3.

The most significant amount of ascorbic acid, 3.34 %, was found in B Natural orange juice and Alo fruit Berries, the lowest ascorbic acid was detected in Frooti juice 1.32 %, Minute Made apple juice 1.58%, pride pinch 1.58 % and Maaza juice 1.60 %. Real fruit power, Enerzol orange and Fruit valley juice contain 2.46% of ascorbic acid. Delmonte fruit juice, Tropicana mix juice and Tropicana pineapple juice contain 2.70 %, 2.81 %, 2.90 % respectively as shown in Table 3.

The maximum amount of citric acid present in the B natural orange juice 5.21 %. The minimum contents of citric acid are in fruity valley mix juice 2.43 % and Paperboat juice alphanso 2.75 %. The other values can be seen in (Table 4).

Al-Harthy and Abukhader[10] identified food additives content in selected snack foods and beverages sold in the Omani market. Citric acid is the most common one and frequently used in all the products. Brima and Abbas[11] analyzed the drinks from the local market of the Kingdom of Saudi Arabia. They reported that the citric acid is used as an additive in different drinks to improve flavor and taste. His results also showed a range of concentration in different samples. 22 % of the samples were shown to have citric acid concentration is higher than 3 g L^{-1}. They suggested that this data can be used to formulate public health awareness.

Conclusion

In this study, we have taken 14 different popular juice samples, consumed most by the Indian children, which are available in the supermarkets of Aurangabad, India. The objective of this research was to evaluate the physical and chemical parameters. Each sample was analyzed for organoleptic or physical tests such as color, texture, flavor, taste and the pH measurement. These findings indicated that the current use of ascorbic acid and citric acid in juices by the fruit juice industry is in below upper limit of FSSAI and are safe for the consumption of children of India.

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