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COMPARISON OF THE QUALITY OF FRUIT JUICES BEING SOLD IN LOCAL MARKETS OF LAHORE, PAKISTAN

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Abstract

Tetra pack fruit juices have become an important part of human diet in relatively hot countries like Pakistan. However, the quality of these juices is not up to the mark in most of the cases. In the current study orange, mango and mixed juices of different brands being sold in the local markets of Lahore city in Pakistan were analyzed for their quality and safety, with reference to their physicochemical and microbial parameters.

The samples of mango, orange and mixed fruit tetra pack juices were collected from local market of Lahore city and immediately transferred to lab. The brix, total soluble solids (TSS), pH, ascorbic acid content and acidity etc., were determined by following the standard methods of AOAC (1990). While, total viable count, fecal coliforms, *Salmonella* sp. and *Staphylococcus aureus* were determined by following the standard methods of APHA (2005).

It was observed that most of the juices under study were not meeting the set standards i.e. having low Brix and ascorbic acid contents etc. Similarly, ash content of all juices was very low indicating a very low amount of pulp. Most of the parameters indicated poor quality and storage stability of more than 80% brands. The microbial analysis divulges

the presence of fecal coliforms, *Salmonella* sp. and *Staphilococcus aureus* in different juices, indicating the poor hygiene as well as serious food safety threats to the consumers.

It is needed to enforce food quality and safety laws strictly so that heath risk associated with consumption of fruit juices may be curtailed in Pakistan.

***Key words**: Tetra-pack Juices, Physico-chemical, Safety, Pakistan.*

1. Introduction

The fertile land of Pakistan produces a variety of fruits such as; mango, banana, peach, pine apple, lychee, grapes and oranges etc. in different seasons of the year. These fruits are processed in to various products such as: jams, jellies pickles and many other products [1]. Fruit juices are one of the most sold products in the markets of Lahore, Pakistan. The main challenge while processing fruit into juice is to maintain its nutrition and hygiene so that a quality product may be delivered to the public. There are laws regarding quality food products production, but many manufactures do not follow these regulations [2].

As a result, adulteration and poor hygiene are proving to be major disaster to public health using these products. One of the major quality issues of the tetra packed fruit juices is its sweet and sour taste which is because of improper sugar and acid content in the juice. Each fruit has its own natural sugar level which determines the amount of water added during its juice preparation [3].

Addition of artificial sweeteners, instead of sucrose, is very common in local industries of developing countries like Pakistan, and the goal for this is earning bigger profit. Since artificial sweeteners are cheap, small amount of this material is enough to add taste, which is a kind of adulteration [4]. However, this procedure represents public health risk, because use of artificial sweeteners may lead towards cancer. Moreover, a slight decrease in ascorbic acid content during the storage of drinks leads towards changed juice color. Change in flavor also occurs during storage due to the production of alcoholic content during storage [5].

Many studies have been carried out to determine fruit juices quality available in local markets [6, 7]. Akhter

et al., reported variable quality of different apple juices in markets of Peshawar, Pakistan [8]. In a similar study the quality of mango juices available in markets of Pakistan was also reported. Such types of studies are necessary to create public awareness regarding to health impacts of the juices available in markets. The current study is conducted to highlight the quality and safety of different orange, mango and mixed juices being sold in markets of Lahore, Pakistan.

Microbes may contaminate the products during fruits harvest, processing, and even during storage. The raw materials, machinery and working environment may also be source of contamination [9]. A reasonable number of: total coliforms, faecal coliforms, *Staphylococcus* spp. and *Salmonella* spp. may exist in vended fruit juices. The main microbial contaminants in fruit juices are: *Staphylococcus aureus, Escherichia coli, Kebsiella* spp., *Streptococcus* spp., *Vibrio cholera* and *Candida albicans* [7].

2. Materials and Methods

2.1 Sampling

The samples of tetra pack juices were collected from local market of Lahore. Samples of mango juice were labeled as M1, M2, M3, M4 and M5. Orange juices were labeled as O1, O2, O3, O4 and O5, while mixed fruit juices were labeled as Mix1, Mix 2, Mix3 and Mix4. The samples were collected and decanted in sterilized glass bottles, sealed tightly, stored in ice box and transported immediately to the Food Safety Laboratory of the Institute of Agricultural Sciences, University of the Punjab, Lahore, for further analysis. Each sample was analysed in triplicates. For the preparation of control samples, healthy fruits were purchased from local market of Lahore, Pakistan and washed thoroughly**.** The juices were prepared following the standard protocols describe by Food & Agriculture Organization [10] and stored at 4 ^{0}C in the laboratory till further analysis. The laboratory prepared control samples of mango juice were labeled as CrlM, orange juice as CrlO and mixed juice as CrlMix.

2.2 Physico-chemical analysis

The standard method of AOAC was used for determination of moisture content [11]. The ash content was determined as described in Pearson's chemical analysis of foods [12]. Total soluble solids were directly recorded by digital refractometer (Atago RX-1000), and the results were expressed as percent soluble solids (°Brix). The acidity, pH and ascorbic acid content of juices were determined by following the methods of Ranganna [13]. The crude protein content of juices was determined by Kjeldahl method [14]. Reducing sugars were determined according to King and Garner [15].

2.3 Microbiological analysis

Total viable count (TVC), total coliforms, fecal coliforms, *E. coli*, *Salmonella spp.* and *Staphylococcus aureus* were determined by following the standard methods of APHA [16]. Most probable number (MPN) technique was used to determine *coliform* bacteria following the serial dilutions. *Staphylococcus aureus* colonies were isolated on blood agar. Lactose broth pre-enrichment was used for *Salmonella* spp. colony count.

2.4 Statistical analysis

All experiments were conducted in triplicate and the data obtained were converted to logarithmic values for uniformity. Means of the replicates were obtained and standard deviations were calculated.

3. Results and Discussion

3.1 Physico-chemical properties

The results of physico-chemical analysis are given in Table 1. Moisture content of most of the tetra pack juices ranged between 82 to 89% while it should be 79 to 81% [17]. Moisture content is important for determining taste and texture of juice, moreover a juice with high moisture content will be lacking its shelf-stability [18].

The ash content depicts total minerals in the juices. When there is high mineral content it means high percentage of pulp is added in the juice. The results in Table 1 show a large variability in ash content, as different brands use different formulations. The lowest ash content was observed in M4 and O4 that is 0.013% while the highest was observed in M5 which is very much lower than that of the laboratory prepared juices, following standard methods, that is 0.2% for CrlM and CrlMix, while 0.31% for CrlO [19].

Protein content is also very important parameter for the fruit juices quality. It is clear from Table 1 that all tetra pack juices sold in markets of Lahore, Pakistan are having very low protein content (< 0.2%) as compared to those prepared in laboratory following standard protocols. The results are in coherence with the report of Sabir *et al.*, [20].

The pH of most of the tetra packed juices ranged 4.2 to 4.7, showing a slight increase in the pH of M1, O2, O4, O5, Mix1 and Mix2, Mix4 and Mix5. The pH of CrlM was 4.4, CrlO was 4.3 and of CrlMix were also 4.2. The slight increase in pH of tetra packed juices might be due to decreased acidity during storage [21]. The acidity is also important parameter of juice quality and it is dependent on juices storage conditions. In many studies it is reported that acidity of juices is decreased with increased storage period [22]. The acidity of CrlM was 0.334, CrlO was 0.351 and CrlMix was 0.343. All samples were having acidity higher than these values except M3, M4 and O4.

Ascorbic acid is an important parameter of nutritional quality of fruits and it is very difficult to retain during juice preparation. The ascorbic acid in CrlM was 3.2 mg/100 mL, in CrlO was 4.4 mg/100 mL and in CrlMix was 3.3 mg/100 mL. The tetra packs sold in market were not having even half of this content that may be result of improper fruit juice processing or complete loss during storage [23].

The °Brix in most of the tetra pack juices was lower than that of Pakistan standards except: M3, O1, O3, O4, Mix3 and Mix4. The °Brix in CrlM was 15, in CrlO was 17 and in CrlMix was 18 complying with the standard specifications [10]. Artificial sweeteners such as: stevia, aspartame, sucralose, neotame, acesulfame potassium (Ace-K), and saccharine are added in fruit juices to maintain its taste, but a very high level of these chemicals is dangerous for human health [24]. Some of these artificial sweeteners are highly toxic and carcinogenic [25]. In one study, these chemicals are found to be correlated with obesity in young girls [26]. They are also found to cause metabolic disorders [27, 28]. So °Brix determination is an important parameter for determination of fruit juices quality. It can be inferred from above results that juices with low degree Brix, but with sweet taste, have very high level of artificial sweetener and are not safe for use.

3.2 Microbiological safety

Through microbial analysis of tetra pack fruit juices it was found that *E. coli and Salmonella* were absent in all samples, as well as in controls. Fecal coliforms and total coliforms count in juices were 1.1 to 1.7 MPN, on average, in all samples, whereas in control samples these were absent. Total plate count (TPC) was varying from 11 to 18 MPN and *Staphylococcus aureus* 1 to 3 MPN in various samples of tetra pack juices, and in controls, TPC was in the range of 5 to 13 MPN and *Staphylococcus aureus* was 0 to 2 MPN (Table 2).

Gravity of microbial contamination should be as low as possible to ensure the consumer safety. It was observed that microbial load was increased during juices storage, and with the time it resulted with increase in pH and decrease in the acidity, and production of alcoholic contents. Change in juices flavor also indicated the presence of microbes. Reduction of microbial load can be done by following good sanitation and hygienic practices during processing and storage of juices. Addition of preservatives up to an acceptable level and storage of juices at refrigeration temperature can be an effective tool for the microbial growth inhibition.

Table 1. Physico-chemical analysis of different fruit juices

Sample Code	Moist. %	Ash %	Bulk Density (g/cm³)	pH	Acidity %	Reducing sugar %	Ascorbic acid (mg/100mL)	Protein %	°Brix
M1	83	0.02	1.034	4.8	0.182	10.6	1.3	0.16	7.4
M2	84	0.015	1.021	4.6	0.239	9.4	1.1	0.15	6.3
M3	87	0.032	0.988	4.3	0.356	8.5	1.8	0.08	11
M4	89	0.013	1.245	4.4	0.292	6.8	1.8	0.13	2.3
M5	82	0.104	0.993	5.5	0.114	4.7	1.5	0.17	4.1
O1	78	0.04	1.21	4.5	0.267	11.2	1.4	0.11	7.2
O2	90	0.07	1.52	4.8	0.245	10.1	18	0.12	9.9
O3	84	0.02	0.786	4.2	0.178	9.8	1.4	1.11	8.9
O4	86	0.01	0.86	4.7	0.254	8.4	1.7	1.16	9.4
O5	82	0.03	1.32	4.9	0.113	1.3	1.6	0.1	10.6
Mix1	82	0.09	1.45	5.3	0.113	9.8	1.2	0.16	8.9
Mix2	84	0.06	0.99	5.8	0.156	10.3	1.1	0.12	11.5
Mix3	83	0.03	0.98	4.2	0.227	9.96	1.4	0.14	7.4
Mix4	84	0.04	0.96	5.1	0.153	10.2	1.3	0.13	8.9
Mix5	86	0.03	0.93	5.3	0.178	8.7	1.2	0.91	9.6
CrlM	79	0.22	1.975	4.4	0.334	10.9	3.2	0.76	15
CrlO	79	0.31	1.45	4.3	0.351	11.2	4.4	0.96	17
CrlMix	81	0.24	1.76	4.4	0.343	11.9	3.3	0.78	18

Table 2. Microbiological analysis of different fruit juices

Sample Code	*E. coli* (MPN)	*Salmonella* (MPN)	Total coliform (MPN)	Fecal coliform (MPN)	Total Plate count (MPN)	*Staphylococcus aureus* (MPN)
M1	n	n	1.3	1.3	11	8
M2	n	n	1.5	1.5	14	7
M3	n	n	1.1	1.1	14	6
M4	n	n	1.4	1.4	13	11
M5	n	n	1.7	1.7	18	12
O1	n	n	1.6	1.6	11	7
O2	n	n	1.1	1.1	16	6
O3	n	n	n	n	12	11
O4	n	n	1.1	1.1	13	13
O5	n	n	1.6	1.6	15	12
Mix1	n	n	1.4	1.4	11	9
Mix2	n	n	1.3	1.3	13	5
Mix3	n	n	1.5	1.5	14	10
Mix4	n	n	n	1.4	12	6
Mix5	n	n	n	1.5	15	7
CrlM	n	n	n	n	1	0
CrlO	n	n	n	n	1	2
CrlMix	n	n	n	n	3	1

- n = negative

4. Conclusions

- The current study reveals that adulteration is common practice by fruit juice processors in Pakistan.

- Artificial sweeteners are being used instead of sucrose, posing the serious health risks to public health. Artificial flavors are being used in juices to overcome the deficiency of pulp that is only for the profit making, resulting in the low nutritional quality of juice drinks. People use unethical means to get more profit without caring the consumer health.

- Presence of fecal coliforms and *Salmonella* spp. etc. may cause serious risk to public health leading towards serious and even deadly food borne illness like: diarrhea, cholera, digestion problems and several other chronic diseases due to the continuous consumption of contaminated foods.

- Most of the poor results for the quality of juices under study may be the result of poor and unhygienic practices, as well as because of prolonged storage before selling in the markets.

- Current study highlights the need of implementation of food safety laws at all levels of juice processing, especially within supply chain to ensure safe products to the consumers.

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