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Formulation and quality assessment of dehydrated lemon and stevia instant drink powder

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Abstract
Powdered drink mixes, also known as instant drink powders, are processed food products in powder form intended to be mixed with water, resulting in a beverage resembling fruit juice or soda in taste. The demand for lemon-flavored drinks increases significantly during the summer season due to their ability to quickly rehydrate and provide a sense of freshness. To meet this demand and offer a high-energy, refreshing, and flavoured drink with added vitamins and minerals, an instant drink powder containing lemon and stevia was developed. The aim of the study was to evaluate its physical, chemical, and sensory properties. To create the instant drink powder, various formulations of lemon, stevia, carom, cumin, and black salt were used. A commercially available drink powder (Tang) served as the control sample (T_0). The prepared samples underwent multiple physicochemical and sensory tests to assess their nutritional value and shelf life. After a 90-day period, the proximate analysis of the instant drink powder revealed that it was suitable for human consumption. In terms of sensory properties, sample T_{13} was found to be as well-liked as the control, based on overall acceptability.

Keywords: Lemon, stevia, instant drink powder, nutritional, beverage mix

Introduction
Lemon holds a prominent position among all citrus fruits, especially within the acidic group. According to the National Horticulture Board (NHB, 2021-22), Andhra Pradesh ranked as the top lemon-producing state in India, followed by Gujarat, Maharashtra, Karnataka, Madhya Pradesh, Odisha, Assam, Telangana, Bihar, and West Bengal. The cultivation of lemons thrives in warm, moderately dry, and moist climates. Although they can grow in various soil types, well-drained light soils are most suitable for their cultivation. The Key lime (*Citrus* × *aurantiifolia*), a citrus hybrid of *C. hystrix* and *C. medica*, is native to tropical Southeast Asia. It produces spherical fruits with a diameter of 25-50 mm (1-2 in). Key limes are smaller, have more seeds, higher acidity, a stronger aroma, and thinner rinds compared to Persian limes (*Citrus* × *latifolia*). Lemons are not only rich in vitamin C but also contain vitamins B5, B6, B_1, and B_2, as well as calcium, copper, iron, and potassium. Their high dietary fiber content and low-calorie nature make them an excellent choice for those aiming to lose weight. Stevia (*Stevia rebaudiana* L.), commonly known as sweet leaf, sugar leaf, honey leaf, or candy leaf, has been used as a natural sweetener by the natives of Paraguay and Brazil for a long time. Stevioside, derived from stevia, is considered safe for use as a sweetener. The stevia plant contains various sterols and antioxidant compounds such as triterpenes, flavonoids, and tannins. Among the flavonoid polyphenolic antioxidant phytochemicals found in stevia are kaempferol, quercetin, chlorogenic acid, caffeic acid, isoquercitrin, and iso-steviol. Studies have indicated that kaempferol may reduce the risk of pancreatic cancer by 23% (American Journal of Epidemiology). Lemon powder is often transformed into a supplement derived from the entire lemon. Although most people typically use only the lemon juice, and do sparingly due to its acidic nature, there has been a recent trend of individuals discovering more economical and convenient ways to incorporate the benefits of whole lemons into their daily routine. Among all fruits and vegetables, lemon stands out as one of the most abundant sources of vitamin C, an essential antioxidant that protects against free radical damage. Free radicals can contribute to various diseases, including cancer, heart disease, and osteoarthritis. A study conducted in 2014 indicated that regular consumption of dried lemon can significantly improve blood pressure, aid digestion, and alleviate common issues like clogged sinuses. Stevia serves as a sugar alternative and has been recognized for its potential to lower blood sugar levels. It is commonly used as an herbal supplement. Instant powder drinks are food preparations in powdered form that dissolve easily in water, making them convenient to serve

and have a long shelf life due to their low water content. The focus of the present study was to create an instant drink powder using dehydrated lemon and stevia leaves. Additionally, the study examined the physicochemical and sensory properties of the prepared instant drink powder.

Materials and Methods

Raw materials and their formulation: The raw materials used were whole key lime, stevia leaves, black salt, cumin and carom that were mixed in different compositions into 13 treatment samples (T_1 to T_{13}) where dehydrated stevia and lemon powder were the variables and rest of the ingredients had the same quantity in every sample. Sample T_0 was the control sample or commercial sample (tang drink powder) purchased from market. Formulations of various samples is presented in table 1.

Table 1: Formulation Table

Z			Factor 1	Factor 2	Factor-3	Factor-4	Factor-5
			Variable		Constant		
Std	Run	Treatment	A: Lemon Powder	B: Stevia	Rock Salt	Cumin Powder	Carom Powder
			gm	Gm	Gm	gm	gm
9	1	T1	87.5	1.125	7.19	1.5	2.5
6	2	T2	105.178	1.125	7.19	1.5	2.5
4	3	T3	100	1.25	7.19	1.5	2.5
13	4	T4	87.5	1.125	7.19	1.5	2.5
2	5	T5	100	1	7.19	1.5	2.5
1	6	T6	75	1	7.19	1.5	2.5
5	7	T7	69.8223	1.125	7.19	1.5	2.5
8	8	T8	87.5	1.30178	7.19	1.5	2.5
7	9	T9	87.5	0.948223	7.19	1.5	2.5
12	10	T10	87.5	1.125	7.19	1.5	2.5
3	11	T11	75	1.25	7.19	1.5	2.5
11	12	T12	87.5	1.125	7.19	1.5	2.5
10	13	T13	87.5	1.125	7.19	1.5	2.5

Preparation of the instant drink powder: The lemons were washed and then cut into uniform slices and dried in a hot air oven (75 °C for 5 hours). The dried slices were then put into a mixer grinder and ground powder was obtained.

The powder was sieved to remove impurities and coarser particles. Stevia leaves were picked and sorted. Then dried at ambient temperature. They were put in mixer grinder in order to obtain a ground powder and the sieved to remove coarser particles. Then the powders were mixed according to various formulations given in table 1 in different air tight pouches and stored at room temperature.

Physicochemical and Sensory Analysis of the instant drink powder: The instant drink powder was analysed for various physicochemical properties and sensory attributes. The moisture, ash, carbohydrate, protein, crude fiber were measured according to AOAC and AAAC (2000) [1] standard methods. The Vitamin C content was was calculated according to the method given by Ranganna (1986) [4]. For sensory properties, a panel of nine judges from Dept of Processing and Food engineering, SHUATS, Prayagraj was selected and the scores were obtained with the help of 9-point hedonic scale.

Results and Discussion

The prepared samples of dehydrated lemon and stevia instant drink powder are shown in Fig 1.

Fig 1: Various formulations of Instant drink powder

Physicochemical properties

The mean (%) of various physicochemical properties is given in Table 2 and plotted in Fig 2.

Table 2: Physicochemical properties

Sample	Moisture	Ash	Protein	Crude Fiber	Vitamin C	Fat	Carbohydrate
T_1	9.24	12.67	1.81	15.13	22.84	2.12	74.15
T_2	9.85	16.44	1.88	15.29	23.01	2.15	69.65
T_3	9.95	16.13	1.85	15.23	23.10	2.13	69.93
T_4	9.24	12.67	1.81	15.13	22.84	2.12	74.15
T_5	9.95	16.13	1.85	15.23	23.10	2.13	69.93
T_6	9.97	12.21	1.76	15.06	22.24	2.08	79.94
T_7	9.89	11.77	1.73	15.02	21.51	1.88	74.92
T_8	9.24	12.67	1.81	15.13	22.84	2.12	74.15
T_9	9.24	12.67	1.81	15.13	22.84	2.12	74.15
T_{10}	9.24	12.67	1.81	15.13	22.84	2.12	74.15
T_{11}	9.97	12.21	1.76	15.06	22.24	2.08	79.94
T_{12}	9.24	12.67	1.81	15.13	22.84	2.12	74.15
T_{13}	9.24	12.67	1.81	15.13	22.84	2.12	74.15

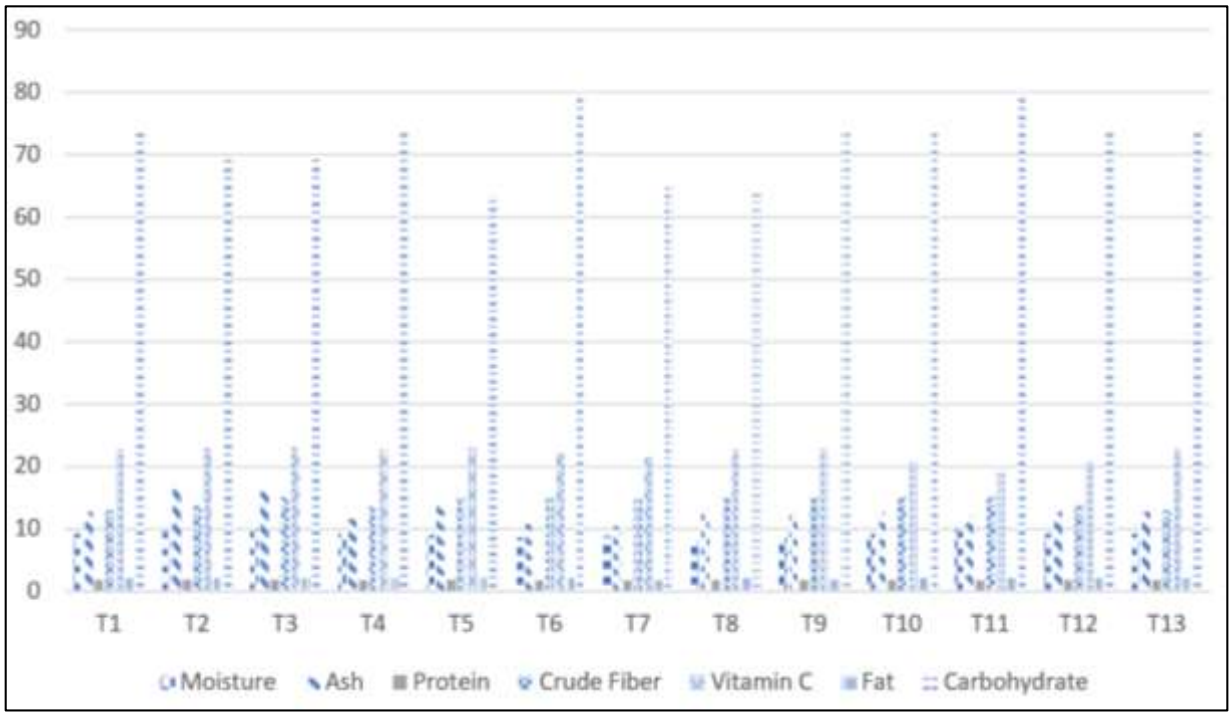

Fig 2: Physicochemical Properties of the Instant Drink Powder

The moisture content of food products plays a vital role in determining their quality and shelf life, as higher moisture levels promote microbial growth, leading to early deterioration. The instant drink powder's overall moisture content was slightly higher compared to the moisture content reported by Akhter *et al.*, (2010) [5] for instant mango powder and Farzana *et al*. (2017) [8] for vegetable soup powder. A higher ash content in food products is indicative of a better mineral source. The ash content of the instant drink powder was higher than that reported by Akhter *et al*. (2010) [5] for instant mango juice powder, as per the findings of Adefemi *et al.*, (2012). Fat serves as a concentrated source of energy, stored in the body and utilized when the carbohydrate source is depleted. It also acts as a protective cushion for internal organs, including the heart, kidneys, lungs, and intestines (Mohammed *et al.*, 2017) [3]. The instant drink powder had a higher fat content compared to that reported by Akther *et al.*, (2020) [7] for instant mango drink powder. The results concerning crude fiber content align with the findings of Akther *et al.*, (2020) [7] for instant mango drink powder. This suggests that the instant drink powder may be a good source of Ascorbic acid (Vitamin C). According to Susanti *et al.*, (2014), this study observed that the drying process can have an impact on the stability of vitamin C, resulting in decreased levels of vitamin C in the treatments. Fruits and vegetables are generally known to have low protein and crude fat content, which was also noted by Akther *et al.*, (2020) [7]. However, the present study's results indicated higher protein and crude fat content compared to that reported by Akhter *et al.*, (2010) [5] for instant mango juice powder.

The carbohydrate content of the formulated instant drink powder was found to be lower than that of a commercial brand of instant drink powder. Nevertheless, the carbohydrate content in the formulated powder was considered acceptable and can serve as a good source of energy. The carbohydrate content of the instant drink powder was higher than what was reported by Mohammed *et al.*, (2017) [3] for instant sorrel (Zobo) drink.

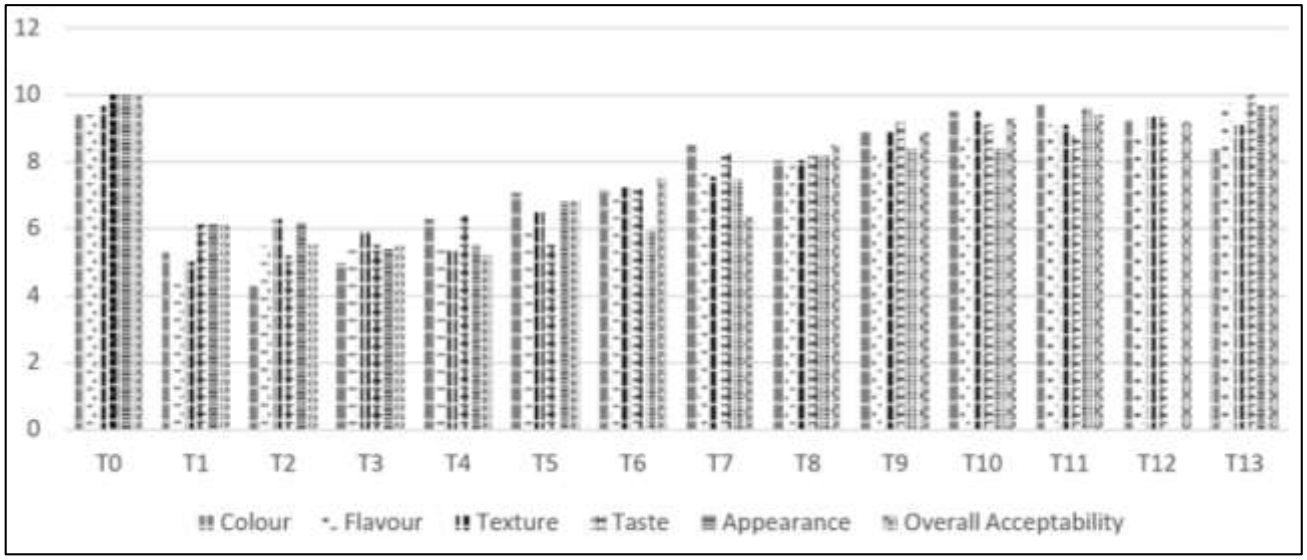

Fig 3: Sensory Evaluation of the Instant drink Powder

Color, taste, flavor, texture, appearance, and overall acceptability are key factors in a food item's acceptance, and these factors are also reliable indications of physicochemical changes that occur during storage. According to Table 3, Sensory Evaluation indicated that, treatment commercial treatment T_0 had the highest score for colour followed by T_{11} and others. For Flavour the commercial treatment T_0 tied with T_{13} at a score of 9.8. In case of texture the commercial treatment T_0 had the best score followed by T_{11} which had 10 and 9.7 respectively. For taste and appearance, the commercial treatment T_0 tied with T_{13} at a score of 10. As far as overall acceptability is concerned, the commercial treatment T_0 and Treatment T_{13} had the highest score i.e., 10.

Conclusion

It can be concluded from the present study that the lemon and stevia instant drink powder has a long shelf life and high proximate constituents that makes it safe for consumption. The nutritional composition was found to be higher in treatment T_2, moisture (13.12%), Ash (15.25%), Protein (1.95%), Fat (2.29%), crude fibre (15.42%). In case of carbohydrate composition, the highest was found in T_7 (74.35%) and Vitamin C content in case of control sample T_0 (35%) was the highest. On the basis of proximate analysis sample T_2 was the best and from sensory evaluation sample T_{13} was the best out of all the prepared samples. The product does not contain any sort of preservatives and it has not gotten spoiled yet as of 90 days and counting. There is a very limited study concerned with nutritional quality of powdered drinks. Thus, more research on nutritional property, bioaccessibility, and consumption limitations of drinking powders are necessary

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