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Reformulating and remodelling of ayurvedic formulations into consumer-acceptable food products

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Abstract
Nutritional supplements and food formulations based on phytochemicals and nutraceuticals are gaining wide acceptance among consumers to improve and maintain general health. In view of this, the current research work was envisioned with the objective of developing sensorially acceptable products based on ayurvedic over-the-counter products *viz*., Ashwagandhadi and Kooshmanda rasayanas, which are used for general upkeep of health and wellbeing. The products developed were *NutriAyur* fills, and cupcakes with Ashwagandhadi and Kooshmanda rasayanas. The proximate values analysed by the AOAC method for the NutriAyur fills, and cupcakes showed appreciable amounts of protein i.e., 10.63±0.009 % and 8.24±1.09 % respectively. Phytoconstituents and dietary minerals i.e., calcium, iron and zinc were also analysed.

Keywords: rasayanas, *Withania somnifera*, *Benincasa hispida*, product development, proximate, vitamin C, polyphenol, sensory analysis

Introduction
The wellness industry is one of the fastest-growing commercial sectors globally and in India. According to FICCI, the current global wellness industry is valued at up to USD 4.2 trillion and for India, the estimate is approx. INR 490 crore [1].
Indian wellness industry flourishes on demand for ancient alternative medicine and healing practices like Ayurveda, Yoga, Naturopathy, Siddha etc [2]. Over the years, these alternative wellness systems have caught the world's attention, especially Ayurveda and yoga. In the recent wake of the coronavirus pandemic, ayurvedic formulations and yoga have found wide acceptance [3].
Usually, the herbal, botanical and bioactive, nutraceutical-based formulations [4, 5] flooding the markets derive their ideas from the fields of traditional medicine systems like Ayurveda, Traditional Chinese medicine system etc [6,7]. However, there is a huge lacuna of scientific data on these botanicals and their biochemical mechanism and, there are issues with sensory acceptability.
The current study was designed to improve the sensory acceptability of the two over-the-counter available ayurvedic supplements by incorporating them into popular eatbles. For this purpose, two ayurvedic formulations called rasayanas [8] based on *Withania somnifera* (Indian Ginseng/ Ashwagandhad) and *Benincasa hispida* (Ash gourd/ Kooshmanda) which are excellent sources of polyphenols, fibre and micronutrients like calcium, phosphorus, potassium, magnesium, vitamin A, vitamin C [9]. A Rasayana is an ayurvedic preparation supposed to promote general well-being and youthfulness [10]. *Withania somnifera or* Ashwagandha (in Sanskrit) has shown a wide range of phytochemical composition and pharmacological activities for e.g., antitumor properties, antioxidant, neuroprotective, and memory enhancing [11, 12]. *Benincasa hispida* commonly called Ash gourd and Kooshmanda in Sanskrit is a widely used crop in culinary in many countries that appreciably contributes to nutrition due to the presence of various dietary minerals (Ca, Mg, Fe, Cu, Zn and Se), vitamins and phytochemicals like triterpenes, phenolics, sterols, and glycosides [11, 13, 14, 15, 16]. Bestowed with valuable nutritive profile, phytoconstituents and pharmacological properties it becomes imperative to use *Withania somnifera* and *Benincasa hispida* to develop products for everyday consumption.
For the study, the ayurvedic formulations were suitably modified for texture, consistency, and taste and then were used to develop *NutriAyur* fills and cupcakes. Further, the remodelled and reformulated products were subjected to sensory and proximate analysis. The scope of the current study lies in exploring the development of products with nutritive and nutraceutical, properties, encouraging the emergence of entrepreneurial ventures and accommodating the adventurous sensorial experience that humans seek.

Materials and Methods
Sample Selection
Ashwagandhadi and Kooshmanda rasayanas were sourced locally from an established and well know Ayurveda pharmacy (SN PANDIT Ayurveda pharmacy). Cocoa powder, chocolate, milk and ghee were locally sourced.

Preparation of blends

The ayurvedic rasayanas were made into blends containing different percentages of ghee, chocolate, cocoa powder, and milk.

a. Three blends (AV1, AV2 and AV3) based on Ashwagandhadi rasayana were made with 37%, 22% and 41% of milk respectively.
b. Three blends (KV1, KV2 and KV3) based on Kooshmanda rasayana were made with 32%, 28% and 40% of milk respectively.

Product development and Sensory analysis

All the six blend variants of Ashwagandhadi and Kooshmanda rasayana were subjected to sensory analysis, further, the most acceptable blend variant based on each rasayana was used to make Ayurvedic fills and cupcakes (*Nutriayur*), the intended product. *Nutriayur* fills and cupcakes were further subjected to sensory analysis using a descriptive sensory score card by a semi-trained panel (N=50).

Proximate composition of the developed products

The most acceptable *Nutriayur* fills, and cupcakes were subjected to proximate analysis (moisture, ash, protein, fats, crude fibre) using AOAC methods [17]. Carbohydrates were calculated by the differential method i.e., by subtracting the total of protein, fat, moisture and ash from 100.

Dietary mineral composition of the products

Dietary minerals viz., calcium, iron and zinc, were analysed using standard AOAC methods [17].

Quantitative antioxidant profiling of the products

To ascertain the quantitative antioxidant profile of the products vitamin C and total polyphenols were quantified using Spectrophotometric and Folin–Ciocalteu methods [18, 19].

Results and Discussion

Sensory analysis of rasayana blends and the subsequent products

Sensory analysis is a crucial step in the process of product development that determines the sensory acceptability of the product leading to its success or failure [20, 21]. The various blends made from Ashwagandhadi and kooshmanda rasayana and thereof products were subjected to descriptive sensory analysis and the descriptors used were taste, aroma, colour, flavour, mouth feel and overall acceptability.

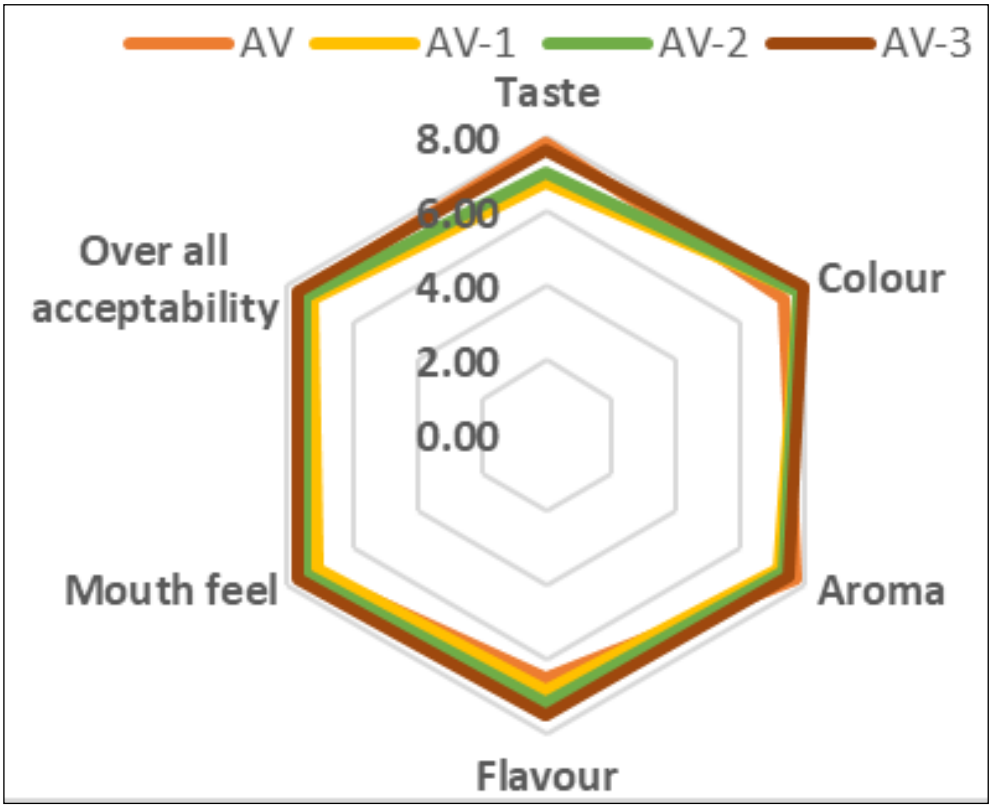


Fig 1: Sensory evaluation of blends based on Ashwagandhadi rasayana

Fig 1. Shows the sensory analysis of the three concoction variants made from Ashwagandhadi rasayana viz., AV1, AV2, AV3. The rasayana in the native form was used as a control for sensory analysis. Blend AV3 scored

better on all the descriptive parameters and therefore was used to develop products. This could be attributed to the addition of ingredients mainly ghee, cocoa powder, and chocolate which remained the same across the variations except for milk 40%. In general, ashwagandha is sold in the form of capsules, powder, tonic and as part of ayurvedic and traditional medicine systems leading to a vast gap to exploit the market for developing products based on it.

Singh S and Goshwami N [22] used ashwagandha powder to make three variations of herbal laddu and the developed laddu with the least per cent of ashwagandha powder (5% incorporation) scored highest on sensory parameters. Ashwagandha is inherently aromatic, has a strong odour (smell of a horse in Sanskrit) and has a characteristic flavour [23] which could be the reason for acceptability at lower concentrations.

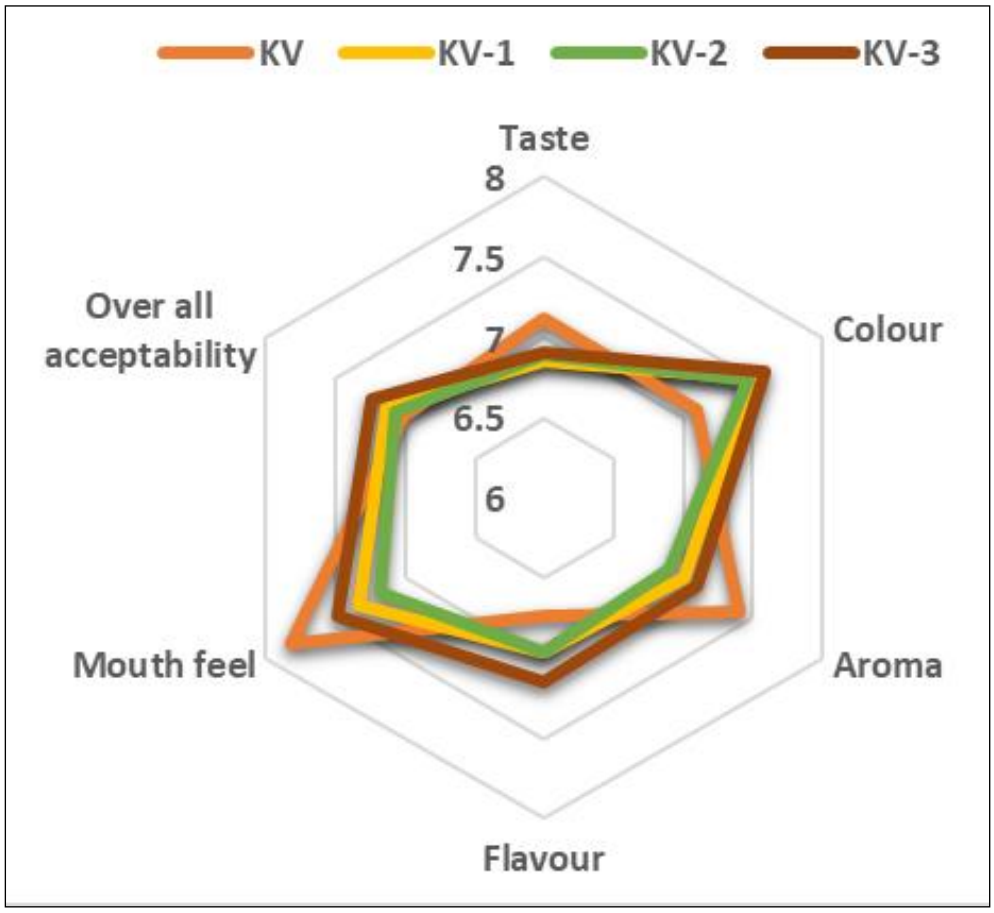


Fig 2: Sensory evaluation of concoctions based on Kooshmanda rasayana

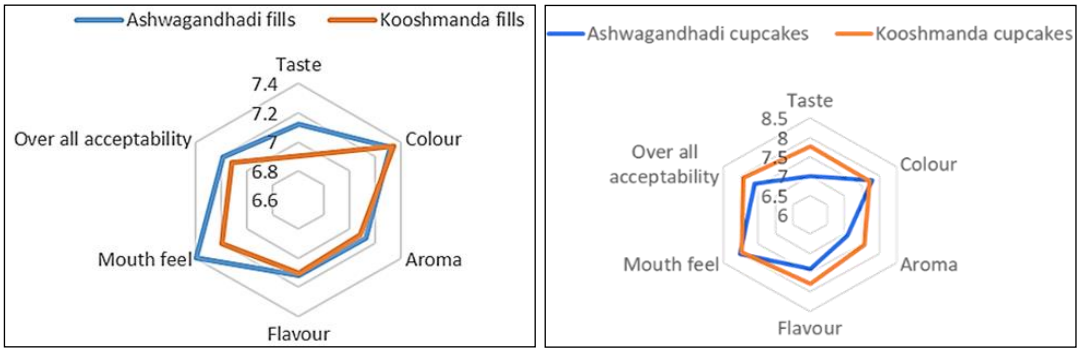
Similarly, Fig 2 depicts the sensory analysis of blends based on Kooshmanda rasayana viz., KV1, KV2, KV3, with KV serving as control. The variation in the blend was per cent of milk used and the rest of the ingredients (refer Ashwagandhadi rasayana blend) used remained the same for all the variations. KV3 blend was the most acceptable by the panel members on all the sensory descriptors. However, all the variations of the blend scored the same on taste descriptors. KV2 scored least on the acceptability scores compared to the KV1, KV3 and control. Being the most acceptable blend, KV3 with 41% milk was used for developing products. Benincasa hispida (Ash gourd) or Kooshmanda was utilized to make value added products viz., sandga and kulfi to exploit the medicinal properties of the crop [24]. A study conducted by Das *et al* [25] showed successful incorporation of ash gourd (Benincasa hispida) in ready-to-eat convenient duck meat with acceptable quality attributes. Being an underutilized crop with medicinal and functional properties there is wide scope for the exploitation of the crop to develop nutritional products for all age groups [26] and the current study is a step in that direction.

Two products were developed using Ashwagandhadi and Kooshmanda rasayana blends: Ayur fills and Ayur cupcakes. Ayur fills were modelled on the popular biscuit-based fills that have chocolate ganache filling in the centre. Ganache is made from chocolate and cream [27] and used for glazing, icing, as a sauce, or filling for pastries and truffles. Most acceptable Ashwagandhadi (AV3) and Kooshmanda rasayana (KV3) blends were used as fillings (exchanged for conventional ganache filling) to make Nutriayur fills (fig 4) and subjected to sensory analysis. Cupcakes, are small cakes and a class of popular bakery products that are usually baked in a small cup-shaped mould and intended to serve one person. Nutriayur cupcakes were developed with the most acceptable Ashwagandhadi (AV3) and Kooshmanda rasayana (KV3) blends (fig 5) and subjected to sensory analysis. In recent years there is an increase in people's awareness about the role of diet in maintaining health and wellbeing, hence an increase in demand for healthy snacks.

Sensory Study of Developed Products

Fig 3: Ayurvedic fills

Fig 4: Ayurvedic Cupcakes



(5a) (5b)

Fig 5a and 5b: Comparison of sensory evaluation of Ashwagandhadi and Kooshmanda fills and cupcakes

Fig 5a & 5b. depicts the comparison of sensory evaluation of Nutriayur Ashwagandhadi and Kooshmanda fills, and cupcakes and Nutriayur Ashwagandhadi fills scored better on colour and overall acceptability parameters compared to Nutriayur Kooshmanda fills. Interestingly Nutriayur Kooshmanda cupcakes were more acceptable compared to Nutriayur Ashwagandhadi cupcakes however on the mouth feel sensory parameter they scored similarly (Fig 6b). Food products are only sustainable in the market if the taste and physical attributes are acceptable to the people [20] and the developed product in the current study depicts the same.

Proximate content of Nutriayur fills and Nutriayur cupcakes

Table 1 depicts the proximate content of Nutriayur fills and Nutriayur cupcakes. Except for protein content, both Nutriayur fills with Ashwagandhadi blend (AV3) and Nutriayur with kooshmanda blend (KV3) cupcakes had similar proximate compositions. Protein was 10.63±0.009 % in Nutriayur fills while it was 8.24±1.09 % in Nutriayur Cupcakes. This could be due to the inherent difference in the protein content of the rasyanas. Carbohydrate was 70.56±0.01 % and 70.7±1.02 % in Nutriayur fills and Cupcakes respectively. FSSAI's Food packaging law makes it mandatory for nutritional information to be provided to help the customers make a healthy choice and is important for export purposes as well.

Table 1: Proximate composition of the Nutriayur fills and cupcakes

Sample	Moisture %	Ash %	CHO %	Protein %	Fat %	Crude fibre %
Nutriayur fills	3.06±0.01	2.25±0.004	70.56±0.01	10.63±0.009	13.48±0.004	1.13±0.008
Nutriayur Cupcakes	4.18±0.42	2.47±0.12	70.7±1.02	8.24±1.09	13.41±0.43	1.08±0.05

The mineral content of Nutriayur fills and cupcakes

Dietary minerals play a crucial role in various physiologic functions and metabolic pathways in the human body like oxygen transport, muscle contraction, nerve impulse conduction, bone health, immune functions, oxidative phosphorylation, maintaining acid-base balance, and antioxidant activity [28]. Three dietary minerals were assessed in the developed products *viz.*, iron, zinc, and calcium. It was found that Nutriayur Cupcakes fared better in terms of iron content (4.46±0.04 mg/100g) compared to Nutriayur fills 2.53±0.04 mg/100g. There was not much variation in zinc and calcium content (table 2).

Table 2: Mineral content of Nutriayur Ashwagandhadi fills and Nutriayur Kooshmanda cupcakes (mg/100g)

Sample	Iron	Zinc	Calcium
Nutriayur fills	2.53±0.04	1.6±0.07	12.25±0.01
Nutriayur Cupcake	4.46±0.04	2.83±0.23	12.23±0.01

Quantitative antioxidant profiling of the products

Antioxidants could be of natural or synthetic origin and help prevent or delay oxidative damage and related pathologies, like atherosclerosis and cancer. Vit C and polyphenols are common antioxidants that have shown antioxidant capabilities in both *in vitro* and *in vivo* studies [29, 30, 31]. Vitamin and Polyphenol content measured in both Nutriayur fills and Nutriayur cupcakes were similar (table 3).

Table 3: Vitamin and total polyphenol content of fills and cupcakes

Sample	Vitamin C (mg/100g)	Polyphenols (mg Vitamin C equivalent/100g)
Nutriayur fills	3.88±0.004	0.017±0.002
Nutriayur cupcakes	3.68±0.93	0.051±0.01

Conclusion

Rasayanas are over-the-counter ayurvedic products, rich in antioxidants and micronutrients and consumed to enhance and upkeep general wellbeing. However, their taste might be of concern. The current research work was an attempt in the direction to utilize the Ayurvedic products i.e., Ashwagandhadi (Withania somnifera) Rasayana, and Kooshmanda (Ash gourd) Rasayana to remodel/refashion them into popular consumer acceptable products. The significance of the research lies in promoting traditional health products in exciting forms acceptable to many.

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