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Development of phyto-chemical enriched cookies with *withania coagulans* and *Cassia auriculata*

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Abstract

The annual growth rate of the demand for bakery goods is 10.07 percent (2019-2015). People now expect ready-to-cook or ready-to-serve convenience foods due to changing lifestyles. Most bakery goods are made with wheat as their primary ingredient. As a result, the inclusion of functional ingredients and nutraceuticals into bakery products is currently a prominent focus. Regarding this, the goal of the current endeavour was to create functional cookies that included phytonutrients from native Indian plants. Incorporating *withania coagulans* (panner poo) and *Cassia auriculata* (aavaram) into wheat cookies while adhering to proper hygiene standards is the choice made. 13 formulations were created in this study using the Response Surface Method (RSM) - Central Composite Design. Its nutritional value per 100 g is made up of total protein (14.84%), fat (20%), carbohydrate (60.89%), and total calories (482.92 percent). Run 9 on the hedonic scale gave the product's sensory qualities the highest rating for overall acceptability.

Keywords: *Withania coagulans*, *Cassia auriculata*, Phytochemicals, Cookies, RSM

Introduction

Bakery sector

The bakery business in India is one of the main divisions of the food processing industry, with approximately 2000 industrial bakeries producing roughly 1.4 million tonnes of bakery products and 1000000 small scale bakeries producing 1.8 million tonnes. India is the world's second-largest cookie maker behind the United States. The annual growth rate of the demand for bakery goods is 10.07 percent (2019-2015). People now expect ready-to-cook or ready-to-serve convenience foods due to changing lifestyles. The bakery sector in India is split into three fundamental categories: Bread, cookies and biscuits, and cakes and pastries (Ishrat Majid *et al.*, 2014) [16]. With concerning to this aspect, the existing undertaking became aimed to increase purposeful cookies with incorporation of phyto-nutrients from indigenous plant life local to India (Goswami *et al.*, 2018) [3]. *Withania coagulans* (Panner Poo) and *Cassia auriculata* (Aavaram) has been selected to include into wheat cookies through following fashionable approach of coaching with suiTable hygiene practices. They enhance the flavor and texture of the food, and purchasers are inclined to include the fitness benefits.

Withania coagulans

Withania coagulans (*W. coagulans*) Dual, frequently regarded as 'Indian cheese maker' or 'vegeTable rennet,' is a plant with inside the Solanaceae own circle of relatives this is used to deal with loads of ailments. Dunal's *W. coagulans* is a tiny gray-whitish shrub determined withinside the Mediterranean region's east.

South Asia is included. In many elements of Pakistan and India, it is a not unusual place medicinal herb. The systematic exam of the glycemic ability of an aqueous extract of *Withania coagulans* end result, in addition to the feature of minerals on this ability, in an effort to set up an powerful and secure opportunity remedy for diabetes mellitus rats (Sudhanshu *et al.*, 2012) [37].

The energetic chemical substances extracted from the plant, particularly with anolides, are idea to have antibacterial, anti-inflammatory, anticancer, hepatoprotective, anti-hyperglycemic, cardiovascular, immuno-suppressive, loose radical scavenging, and CNS *Withania coagulans* is used to deal with the following

- Indigestion.
- Diabetes mellitus.
- Liver disorders.

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- Purification of blood.
- Controls blood pressure.

In addition, it's miles suggested to manipulate plasma glucose stages and stopping renal complications.

1. *Cassia auriculata*

Avaram, Avari panchaga, Chooram, Kalpa natural tea, Ranawara, cauriculata, Tanners cassia are all names for *Cassia auriculata*. *Cassia auriculata* is an evergreen plant determined in India and Asia. In Ayurvedic medicine, the flower, leaves, stem, root, and unripe end result are utilised for remedy. Diabetes, eye infections, joint and muscular discomfort, constipation, jaundice, liver illness, and urinary tract illnesses are all handled with *Cassia auriculata*. We take into consideration turning the bloom into super- completed goods. Consumption of plants is a wonderful remedy for diabetics (Murugan *et al.*, 2013) ^[19]. The leaves are alternate, stipulate, paripinnate compound, very numerous, carefully placed, rachis 8.8-12. Five cm lengthy, narrowly furrowed, slender, pubescent, with an erect linear gland among every pair of leaflets, leaflets 16-24, very rapidly stalked 2-2. Five cm lengthy 1-1. Three cm broad, barely overlapping, oval oblong, obtuse, at each ends, mucronate, glabrous or minutely downy, stupid green.

The systematic assessment and the function of minerals in glycemic ability of aqueous extract of *Withania coagulans* end result in an effort to increase an powerful and secure opportunity remedy for diabetes mellitus (Jaiswal *et al.*, 2009) ^[6]. Laser Induced Breakdown Spectroscopy became used for glycemic detail detection and decreasing in blood glucose stages of normal, sub, moderate and seriously diabetic rats assessed at some point of fasting blood glucose, glucose tolerance take a look at and publish prandial glucose.

Its plants are irregular, bisexual, shiny yellow and massive (almost five cm across), the pedicels glabrous and 2. Five cm lengthy. The racemes are few-flowered, short, erect, and crowded in axis of higher leaves which will shape a massive terminal inflorescence stamen barren; the ovary is superior, unilocular, with marginal ovules (Kumaran *et al.*, 2007) ^[12]. *Cassia auriculata* has been used withinside the Ayurveda as tonic, astringent withinside the remedy of diabetes. *Cassia auriculata* is the constituent of Indian natural components called Avaaripanchangachooram` (Nille *et al.*, 2015) ^[23].

Uses of *Cassia auriculata*

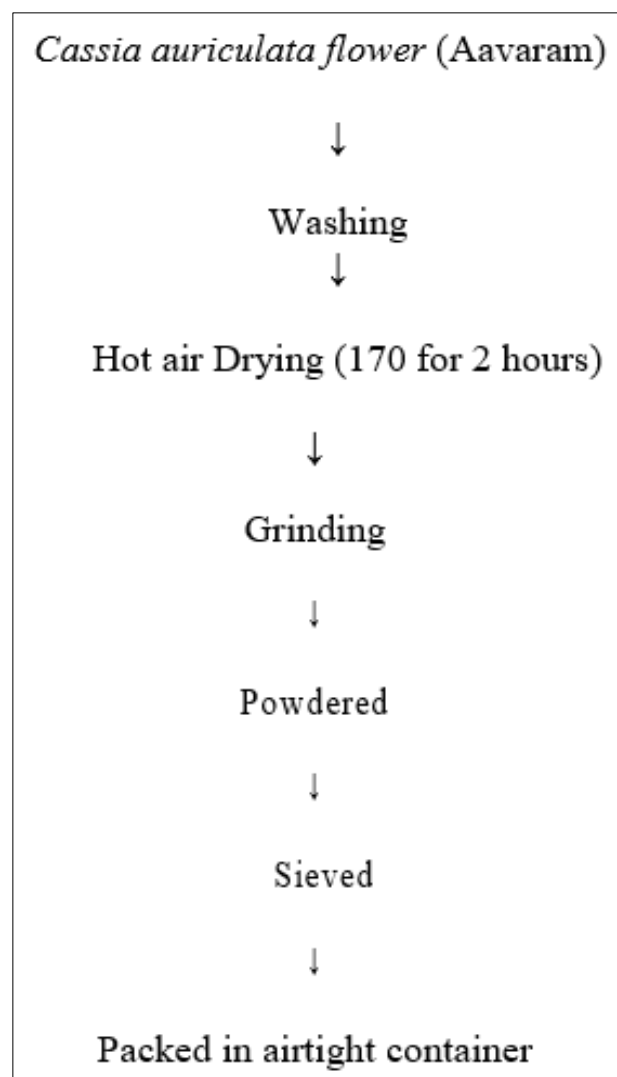
- *Cassia auriculata* is used to deal with the following:
- Diabetes.
- Joint and muscle pain (rheumatism)
- Eye infections (conjunctivitis).
- Constipation.
- Liver disease.
- Urinary tract illnesses

Materials and Methods procurement of raw material

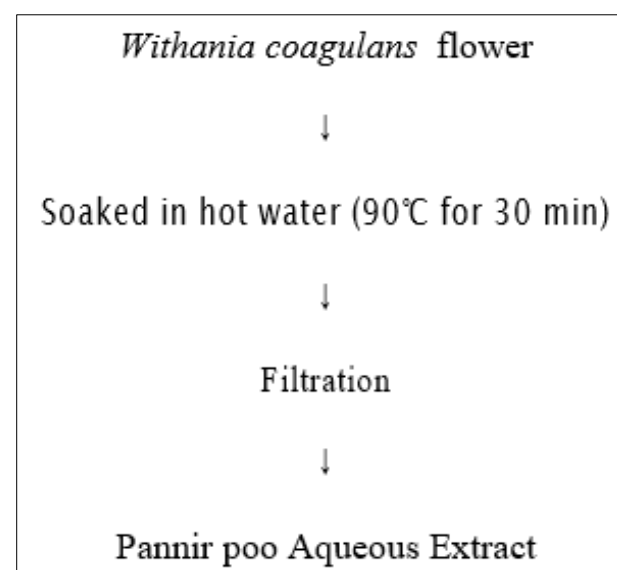
Good quality of *Withania coagulans*, *Cassia auriculata*, Wheat (soft), Sugar, Butter, Milk powder, Custard powder, vanilla extract.

Preparation of *Cassia auriculata* powder (aavaram poo)

Flowchart for preparation of *Cassia auriculata* flower (aavaram)



Preparation of *withania coagulans* aqueous extract Flowchart for preparation of *Withania coagulans* Aqueous Extract



Proximate analysis of *Cassia articulata* powder and *Withania coagulans* extract

Proximate analysis of *Cassia articulata* powder and *Withania coagulans* extract

Composition	Cassia articulata Powder	Withania Coagulans Extract
Fibre (%)	4.05	0.00
Moisture Content (%)	4.35	88.45
Fat (%)	1.89	0.89
Protein (%)	8.22	3.59
Ash (%)	1.07	0.9
Carbohydrate (%)	80.42	6.17

Preparation of formulated cookies

Flowchart for preparation formulated cookies

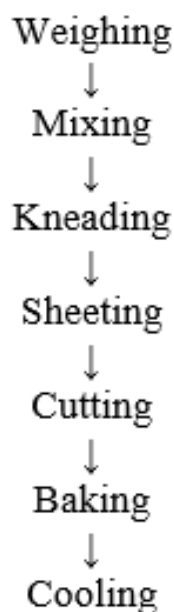


Fig 1: Show cookies preparation formulated cookies

Preparation formulated cookies

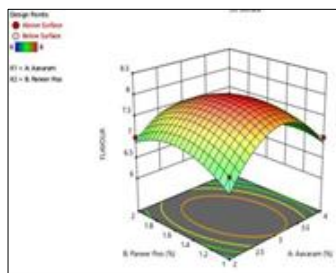
The cookie was prepared with the raw materials *Withania coagulans*, *Cassia auriculata*, Wheat fluffy consistency. Add sugar to the butter and cream it well. Wheat flour, composite powder, salt and baking powder are well mixed together. Sheet the dough and cut into desired shapes. Before baking the oven is pre-heated at 180°C for 5 mins, then it is transferred to a greased tray place it in the oven. Bake the cookies at 175 °C for 25mins, cooled it for a while after

baking.

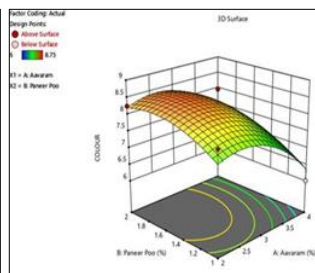
Results and Discussion

This chapter deals with the result obtained from the various experiment conducted on *Cassia auriculata* Powder and *Withania Coagulans* extract incorporated cookies and to estimate the nutritional quality by chemical analysis, microbial analysis, physical analysis and sensory analysis.

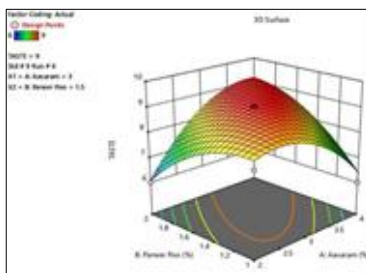
Optimization of fictional cookies using RSM



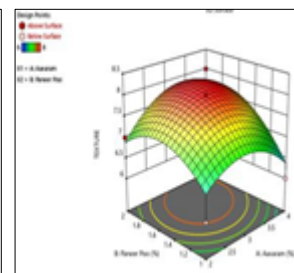
3D surface analyses for Flavour
Response 1: Flavour



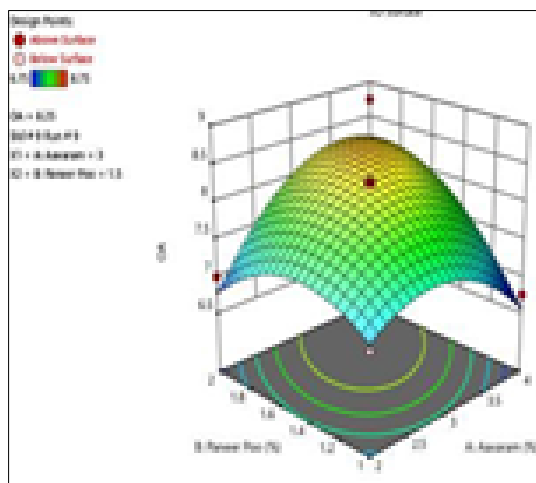
3D surface analyses for Colour
Response 2: Colour



3D surface analyses for Taste
Response 3: Taste



3D surface analyses for Texture
Response 4: Texture



3D surface analyses for overall acceptability
Response 5: Overall acceptability

Number	Cassia auriculata powder	Withania coagulans extract	Flavour	Colour	Taste	Texture	Overall acceptability	Desirability	Selected
1	3.000	1.600	7.957	8.358	9.000	8.053	8.289	0.917	

Response surface modeling analysis based on Five-level-five-factor central composite (circumscribed) design (CCD) approach was applied to evaluate predict and optimize the formulated cookies. 3D surface analyses of all five factors obtained dome shape, optimized result was RUN1 (R1) and the red colour is highly desirable region, which the formulated cookies was obtained by *Cassia auriculata* powder 3% and *Withania coagulans* extract 1.6%.

Functional properties of *Cassia auriculata* and *withania coagulans* extract powder

The results of the functional properties of *Cassia auriculata* Powder and *Withania Coagulans* Extract incorporated cookies were presented in Table 4.1 Ezeama (2012) defined functional properties of food as those Physico-chemical properties or characteristic of food components that determines the usefulness and success of ingredients in food systems.

Functional properties

Functional properties	Rustle
Ph	4.95
Bulk density(g/cm3)	0.384g/cm3
Water absorption capacity(g/ml)	2.8g/ml
Oil absorption capacity(g/ml)	1.4g/ml
Wettability	58 sec
Flow ability	38.650 (moderate)

Proximity analysis of *Cassia auriculata* and *withania coagulans*

Extract Incorporated Cookies

Proximity analysis of incorporated cookies (T₉) presented in the Table Proximity analysis of cookies

Composition	Control	Treatment(R1)
Fibre (%)	2.75%	6.25%
Moisture Content (%)	3.16%	3.19%
Fat (%)	18.83%	20%
Protein (%)	4.788%	14.84%
Ash (%)	2%	3.92%
Carbohydrate (%)	72.22%	60.89%
Energy K. Cal	477.502K.Cal	482.92k.Cal

Physiochemical values of the formulated cookies

S. No	Parameter%	Formulated cookies
1	Moisture content	3.19
2	Ash content	3.92
3	Protein	14.84
4	Fiber	6.25
5	Total fat	7
6	Carbohydrate	72.22
7	Energy (Kcal)	38.156

Proximate analysis for formulated cookies was estimated in cured fiber 6.25% compared to controlled cookies 2.75% formulated cookies fiber content is 4.5% higher than controlled cookies. Similar result were reported in fortified cookies. Curde fibre of the sample (R1) was estimated 3.19% and the moisture content in control is 3.16% the length of time for which a formulated cookies remains usable, shelf life is similar to controlled result. The fat content in formulated cookies result was 20% when compared to control there is an slight different in fat content 2% higher than the result. Formulated cookies 10.052% of protein content is increased compared to the controlled cookies. Ash contentn (T₉) 3.92%, the higher value of ash content was observed. Total carbohydrate content of formulated cookies was 60, 89%. The calories was estimated 381.56% increase in the dietary fiber and reduction in caloric content of formulated was observed.

Physical properties of cookies

The physical properties of *Cassia auriculata* Powder and *Withinia Coagulans* Extract incorporated cookie (T₉) and control were analysed.

Cookie thickness

Cookies thickness were measured with the vernier caliper.

Cookies thickness

S. No	Cookies Thickness for T ₉
1	0.6
2	0.5
3	0.5
Average	0.5

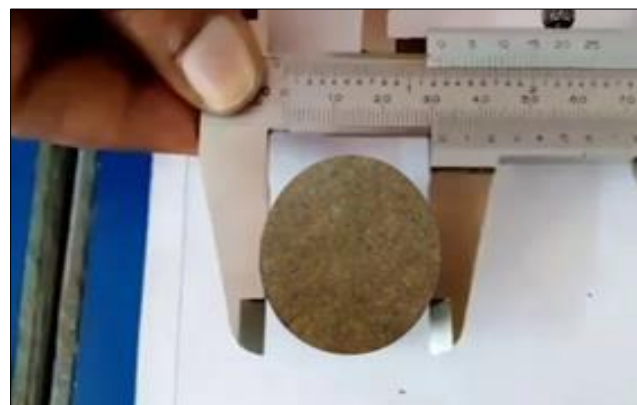
Formulated cookies thickness result, Average = 0.5

Cookie Diameter

The diameter of cookie was measured by placing a cookie from edge to edge and measuring with a vernier caliper.

Cookies Diameter

S. No	Cookies Diameter for T ₉ (cm)
1	3.0
2	3.2
3	3.2
Average	3.1



Cookies Diameter Formulated cookies Diameter result, Average = 3.1

Spread ratio

The spread ratio was obtained by dividing the diameter of the cookie with thickness Spread ratio=Average value of diameter/Average value of thickness =3.1/0.5 =6.2

Spread ratio of the formulated cookies is 6.2cm

Phytochemical analysis of formulated cookies
Phytochemical analysis

S. No	Chemical Constituent	Figures	Inference
1	Saponin test		Formation of emulsion confirms the positive presence of saponin.
2	Tannin test		Appearance of blueish color indicate the positive presence of tannin.
3	Flavonoids test		Appearance of yellow colour is indicates the positive presence of flavonoids.
4	Cardiac glycoside and Cardenolides test		Appearance of violet green ring below the brown ring in the acetic acid layer indicates the positive presence of cardiac glycosides and Cardenolides.

Storage study (35 days) at room temperature

Storage study

Parameter	Sample	0th day	7th day	14th day	21st day	28th day	35th day
Peroxide value	Control	2.12±0.03	2.12±0.04	2.17±0.04	2.24±0.01	2.28±0.03	2.34±0.01
	T ₉	2.03±0.02	2.03±0.03	2.06±0.04	2.08±0.00	2.13±0.02	2.16±0.01
Moisture Content	Control	3.16±0.05	3.16±0.05	3.16±0.06	3.16±0.06	3.16±0.05	3.14±0.07
	T ₉	3.19±0.04	3.19±0.06	3.19±0.05	3.19±0.06	3.19±0.04	3.17±0.06
Phyto-chemicals	Control	-	-	-	-	-	-
	T ₉	+	+	+	+	+	+

Peroxide value

The peroxide value is a measure of the oxidation presenting the sample (T_9), its value measures the oxidative rancidity or degree of oxidation of the fat of the sample. Peroxide value of controlled sample in 0th day was 2.12 ± 0.03 while on 35th day was 2.34 ± 0.01 and for the formulated cookies on 0th day was 2.03 ± 0.02 and 35th day was 2.16 ± 0.0 .

The formulated cookies showed decreased oxidation rate due to addition of *Cassia auriculata* powder and *Withania coagulans* extract. The antioxidative property of *Cassia auriculata* powder and *Withania coagulans* extract resulted in lower peroxide value than control cookies (Kumaran and karunakaran, 2006) [12].

Moisture Content

The weight of the water contained in a formulated cookies is referred to as the moisture content (or water content). Moisture content was analysed in controlled sample 0th day was 3.16 ± 0.05 while on 35th day was 3.14 ± 0.07 and for the formulate cookies on 0th day was 3.19 ± 0.04 and 35th day was 3.17 ± 0.06 . The formulated cookies was packed in poly propylene bag that was showed similar rate due to addition of *Cassia auriculata* powder and *Withania coagulans* extract. Which resulting in crisp texture and good storage stability and is settled in end of the storage.

Phyto-chemicals

Any of the many physiologically active substances that can be found in plants. In Phyto-chemicals storage analysis the control value for 0th day and 35th day was negative because there was no nutrition content. In T_9 *Cassia auriculata* powder and *Withania coagulans* extract was added in formulated cookie and phyto-chemical properties was positive.

Microbial analysis

Days	Bacterial count	Yeast and mould (CFU/g)
0	3×10^5	Nil
7	8×10^5	Nil
14	15×10^5	Nil
21	25×10^5	Nil
28	31×10^5	Nil

Plate count during the initial period bacterial colonies was less, in the log phase bacterial growth was very rapid and slowly increased of colonies during 7th day got doubled and then colony growth was less in 28th day microbial hazards are eliminated.

Yeast and mould count for the Formulated cookies were found to be Nil till the 28th day of analysis. so, it is said to be increased shelf-life product.

Cost Analysis

Table 1: Cost Analysis

Ingredients	Market Rate (Rs)	In kg / g	Expenses (Rs)	In (g)
Wheat	50	1kg	5	100
Sugar	35	1kg	2.10	60
Butter	400	1kg	24	60
<i>Withania coagulans</i>	250	100g	1	4
<i>Coagulans auriculata</i>	250	400g	0.625	1

Material cost = 32.75 Rs Packing cost = 2 Rs Production cost = 5.25 Rs

Total cost = 40 Rs (For 25 Cookies per 8g)

It is estimated that cost of production was Rs.1.6 per 8g of formulated Cookies. When compared to other the price may slightly lower because of raw materials are procured from local markets. Which is high in m and raw material used and the overall product is highly nutritious.

Summary and Conclusion

Nowadays, consumers are increasingly aware of the nutritional impact of the food products in human system. The incorporation of wheat flour with *Cassia auriculata* powder and *Withania coagulans* extract is a way to improve the nutritional value of cookies. The supplementation of wheat-cookies with *Cassia auriculata* powder and *Withania coagulans* will help in improving their nutritional value and will make available functional foods. The present study was undertaken to assess the effect of supplementation of wheat cookies *Cassia auriculata* powder and *Withania coagulans* extract flour on their nutritional, organoleptic and keeping quality. The results have been summarized as given below under: A process for the preparation of formulated cookie was developed. Formulated cookies using Response Surface Methodology (RSM). Sensory analysis, proximate analysis and microbiological analysis were done. Sensory analysis revealed maximum scores for the *Cassia auriculata* and *Withania coagulans* incorporated cookie prepared. In the RSM Table, it is concluded that Run 9 (4% Avarampoo powder and pannir poo 1.5%) has good acceptability when compared to other samples in terms of colour and appearance, body and texture, smell, taste, overall acceptability. From the proximate analysis, it was found that t Run 9(4% Avarampoo powder and 1.5% pannir poo extract) has high amount of protein (14.84%), fat (20%) and fibre (6.25%), moisture content (3.19%), Ash (3.92%) and Carbohydrate(6.89%).The functional properties of *Cassia auriculata* powder like bulk density, water absorption capacity, Oil absorption capacity, Wettability and Flowability were analyzed.

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