



Research Article:

FORMULATION AND EVALUATION OF POLYHERBAL UNCOATED NUTRACEUTICAL TABLETS FOR MANAGEMENT OF POLYCYSTIC METABOLIC SYNDROME

Soumik Halder* 1 , Wrijula Mukerjee 1 , Rakhi Samaddar 1 , Dr. Nityananda Mondal¹, Mr. Sanjiban U. Sarkar¹, Chowdhury Mobaswar Hossain ²

¹ Department of Pharmaceutics, B.C.D.A. College of Pharmacy & Technology, 78/1 Jessore Road (S), Hridaypur, Kolkata – 700127, West Bengal, India

² Department of Pharmaceutical Technology, Maulana Abul Kalam Azad University of Technology, NH-12, Haringhata, Simhat, Nadia – 741249, West Bengal, India

Corresponding Author

Soumik Halder

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Abstract

Polycystic metabolic syndrome(PCMS) is a complex multifactorial endocrine and metabolic disorder that is associated with reproductive dysfunction, hyperandrogenism, insulin resistance, oxidative stress, and alterations in lipid metabolism. This complexity of the disorder has led to the development of complimentary nutraceutical strategies using multiple plant-based bioactive compounds. In the current research work, a polyherbal uncoated nutraceutical tablet was formulated and evaluated that consisted of Trigonella foenum-graecum powder, Curcuma longa, Cicer arietinum powder, and Nigella sativa powder as principal nutraceutical compounds. Artocarpus heterophyllus powder was used as natural flavoring agent whereas Lens culinaris powder served as a natural diluent. Dry starch was used as disintegrating agent. Microcrystalline cellulose (MCC 101). and HPMC(Grade K4) based excipients played role of binders and matrix formers. Magnesium stearate (MGS) and talc served as lubricant and glidant respectively. Aspartame was added as sweetener and Isopropyl alcohol (IPA) as granulating solvent during wet granulation.

The preparation process involved wet granulation of formulation followed by compression of granules into uncoated tablets. Evaluation of physical properties of granules included angle of repose, bulk density, tapped density, Carr's compressibility index and Hausner's ratio. Tablets were evaluated on the basis of their appearance, weight variation, thickness, hardness, friability, disintegration time and in vitro dissolution behavior. The



optimized illustration formulation showed satisfactory flow properties, adequate mechanical strength, low friability and fast disintegration. The formulated tablet had acceptable tablet weight variation and satisfactory dissolution behavior. The use of different plant ingredients resulted in multi-component nutraceutical strategy to target metabolic and oxidative stress associated aspects of PCMS. Further standardization, stability, bioavailability studies and clinical trials are required to prove efficacy and safety of this nutraceutical product.

Keywords: Polyherbal tablet, nutraceutical, PCMS, fenugreek, curcumin, Nigella sativa, black chickpea, jackfruit seed

INTRODUCTION

Polycystic metabolic syndrome(PCMS) is an endocrine condition characterized by multiple metabolic, reproductive and hormonal disruptions. Other than menstrual dysfunction and excessive levels of androgens, most patients suffering from PCMS also display insulin resistance, problems with glucose metabolism, dyslipidemia, chronic low-grade inflammation and oxidative stress. The treatment of such a disease entails addressing multiple metabolic and reproductive factors rather than focusing on one target. (**Azziz et al. 2016**)

Natural products and their metabolites have recently gained more interest as complementary therapy for PCMS as certain natural products are known for their antioxidant properties, glucose regulating and lipid modulating functions as well as anti-inflammatory effects. (Menon et al. 2005)

Jackfruit seeds are also nutritionally valuable and contain carbohydrates, proteins, fibre and phytochemicals. In the present formulation, jackfruit seed powder was incorporated principally to improve the sensory characteristics. (**Teede et al., 2023**)

Fenugreek (*Trigonella foenum-graecum*) seeds contain dietary fibre, steroidal saponins and other phytoconstituents and have attracted interest for their potential metabolic effects. Lens culinaris powder(Lens culinaris) was selected as a natural diluent because of its nutritional composition and availability, whereas dry starch was selected as a conventional tablet disintegrant. MCC 101 and HPMC were incorporated to improve granule formation and tablet mechanical properties. (**Alu'datt et al., 2024**)

Magnesium stearate and talc were used to improve lubrication. Turmeric(*Curcuma longa*), the major bioactive component associated with turmeric, possesses antioxidant and anti-inflammatory properties. Kalo jeera (*Nigella sativa*) has also been investigated in relation to PCMS. Its major bioactive constituent, thymoquinone, has antioxidant and anti-inflammatory properties. Black chickpea (*Cicer arietinum*) is a nutrient-rich legume containing protein, dietary fibre, minerals and various phytochemicals. Its incorporation into a nutraceutical formulation provides a food-derived



source of nutritional and phytochemical constituents. (Chatterjee et al., 2025)

MATERIALS

Fenugreek (*Trigonella foenum-graecum*) powder has been obtained from Nourish Commodities Limited. Turmeric powder (*Curcuma longa*) was obtained from Cookme Pvt. Ltd., Black chickpea (*Cicer arietinum*) powder has been ordered from Nourish Commodities Limited, Kalo jeera (*Nigella sativa*) powder have been ordered from Earth Crust Private Ltd. Jackfruit (*Artocarpus heterophyllus*) seed powder has been obtained from Kerala Naturals.

Lens culinaris powder (*Lens culinaris*) has been obtained from Local Resources. Dry starch was a gift sample from Nice Chemical Lab. Microcrystalline cellulose grade 101 has been ordered from SRL Lab, Hydroxypropyl Methylcellulose (HPMC K4) was ordered from Nice Chemical Lab., Isopropyl alcohol (IPA), magnesium stearate is obtained from Loba Chemic Pvt Ltd, talc was ordered from Research lab company and aspartame were available at the lab facility of BCDA college of Pharmacy and Technology. All those were used for the formulation of polyherbal uncoated nutraceutical tablets. All other chemicals and reagents used were of analytical grade and distilled water was used wherever required.

METHOD

The formulation was prepared by the **wet granulation method**, which was selected to improve the flowability, compressibility, and handling characteristics of the polyherbal powder blend. Wet granulation using PVP K-30 as a binder is a commonly reported approach for herbal tablet preparation.

Preparation and Processing of Natural Ingredients

The natural ingredients, namely **jackfruit (*Artocarpus heterophyllus*) seed powder, lentil cell powder, fenugreek (*Trigonella foenum-graecum*) seed powder, *Nigella sativa* powder, turmeric (*Curcuma longa*) powder, and black chickpea (*Cicer arietinum*) powder**, were procured from the local commercial market. The raw materials were visually inspected to remove foreign matter and other extraneous materials. The materials were subsequently subjected to appropriate preliminary processing, including cleaning, drying and size reduction, wherever required, before being converted into uniform powders. (Li et al. 2021)

The processed powders were passed through a suitable sieve to obtain relatively uniform particle size and to remove coarse particles and agglomerates. The sieved powders were collected separately in clean, dry, labelled containers until formulation. Such preliminary size standardization is useful for achieving better uniformity during subsequent blending and granulation.



Preparation of Powder Blend

The accurately weighed quantities of the natural ingredients were taken according to the composition of **F1**. Jackfruit seed powder, lentil cell powder, fenugreek seed powder, *Nigella sativa* powder, turmeric powder, and black chickpea powder were transferred to a clean mortar or suitable mixing vessel.

Microcrystalline cellulose(Grade 101) was then incorporated as a diluent. The powders were mixed thoroughly by geometric dilution to obtain a homogeneous dry blend. The blending step was continued until a visually uniform distribution of the individual powders was obtained.

Preparation of Binder Solution

PVP K-30 was used as the binding agent. It was gradually dissolved in **isopropyl alcohol** with continuous stirring to obtain a uniform binder solution. Isopropyl alcohol was used as the granulating liquid in accordance with the selected formulation. PVP K-30 dissolved in an alcoholic granulation medium is a documented approach in wet-granulation processes.

The quantity of isopropyl alcohol was maintained **q.s.**, depending on the quantity required to achieve the appropriate granulation endpoint.

Wet Granulation

The prepared PVP K-30 binder solution was added **gradually and portion-wise** to the previously prepared powder blend with continuous mixing. The mass was kneaded carefully after each addition to ensure uniform distribution of the binder throughout the powder bed.

The addition of the binder solution was continued until a **uniform, cohesive and slightly moist mass** was obtained. Excessive addition of granulating liquid was avoided because over-wetting may produce dense, hard granules and prolong the drying process. The endpoint was considered satisfactory when the wet mass exhibited sufficient cohesiveness to form granules without being excessively sticky.

The resulting wet mass was passed manually through an appropriate sieve, preferably **#16–#20 mesh**, to produce uniformly sized wet granules. Wet granulation procedures reported in the literature commonly involve passage of the wet mass through a coarse sieve followed by drying and subsequent sizing.

Drying of Wet Granules

The freshly prepared wet granules were spread uniformly as a thin layer on suitable trays and dried in a **hot-air oven/tray dryer at approximately 50–60°C**. Drying was continued until the granules attained a satisfactory moisture level and became free-flowing. A controlled drying temperature is important for minimizing excessive thermal exposure of plant-derived constituents.

After drying, the granules were allowed to cool to room temperature in a dry environment. Published wet-granulation studies have used drying temperatures around 60°C for PVP-containing



formulations, including systems using alcoholic granulating media.

Sizing of Dried Granules

The dried granules were passed through a suitable sieve, such as #20 , to break up larger agglomerates and obtain a relatively uniform granule size. The oversized material was gently passed through the sieve without excessive mechanical force. The final granules were collected and stored temporarily in a clean, dry container.

The prepared granules were subsequently evaluated for relevant **pre-compression characteristics**, including angle of repose, bulk density, tapped density, Carr's compressibility index, Hausner's ratio and particle-size distribution. Wet granulation is commonly employed to improve the flow and compressibility of herbal powder systems before compression.

Lubrication and Final Blending

After drying and sizing, the required quantities of **talc** and **magnesium stearate** were added to the dried granules. The materials were blended gently and uniformly to provide adequate flow and reduce friction during the subsequent compression process. Magnesium stearate is commonly incorporated as a lubricant, whereas talc can improve powder/granule flowability.

Aspartame was incorporated as a sweetening agent and blended carefully with the dried granules. The final lubricated granule blend was mixed sufficiently to ensure uniform distribution of the extragranular components while avoiding excessive blending with magnesium stearate, which can adversely affect tablet properties when overmixed.

Compression into Tablets

The final lubricated granules were transferred to the hopper of a suitable tablet compression machine. The granules were compressed using appropriately sized punches and dies according to the intended tablet weight and dimensions. The compression force was adjusted to obtain tablets with adequate mechanical strength while maintaining acceptable disintegration characteristics.

The prepared tablets were collected, visually inspected for defects such as capping, lamination, sticking and mottling, and stored in a **clean, dry, well-closed container** until further evaluation.

EVALUATION OF POWDER BLEND

Particle size distribution

The measurement of particle size distribution was performed by sieving method using vibration sieve apparatus. A sieve stack with six sieves in aperture progression was loaded with powder on to the coarsest sieve of the assembled stack and nest is subjected to mechanical vibration. After 10 min, the particles are considered to be retained on the sieve mesh; then weighed the powder retained in the sieves and the respective parameters were calculated.



Drug–Excipient Interaction Study

The drug, polymer and other formulation ingredients were characterized by IR spectroscopy using a FTIR 8400S (Shimadzu, Japan). The spectra were taken by KBr discs method in the range of 4700–400 cm⁻¹.

Bulk density

It is a ratio of mass of powder to bulk volume. The bulk density depends on particle size distribution, shape and cohesiveness of particles. Accurately weighed quantity of powder was carefully poured in to graduated measuring cylinder through large funnel and volume was measured, which is called initial bulk volume. It is expressed in gm/ml and is given by the formula

$$\text{Bulk density} = M/V_o$$

Where, M = mass of the powder

V_o = bulk volume of the powder

Tapped density

Ten gram of powder was introduced into a clean, dry

100 ml measuring cylinder. The cylinder was then tapped 100 times from a constant height and the tapped volume was read. It is expressed in gm/ml and is given by

$$\text{Tapped density} = M/V_t$$

Where, M = mass of the powder

V_t = final tapping volume of the powder

Angle of repose (θ)

It is defined as the maximum angle possible between the surface of the pile of the powder and the horizontal plane. Fixed funnel method was used. A funnel was fixed with its tip at a given height 'h', above a flat horizontal surface to which a graph paper was placed. Powder was carefully poured through a funnel till the apex of the conical pile just touches the tip of the funnel. The angle of repose was then calculated using following equation

$$\text{Angle of repose } \theta = \tan^{-1}(h/r)$$

Where, h = height of the pile

r = radius of the pile

Preliminary Phytochemical Screening

Test for Alkaloids

The powder blend was treated with Dragendorff's reagent. Formation of an orange or reddish-brown precipitate indicated the presence of alkaloids. (Nortjie et al., 2022)

Test for Flavonoids

The blend was treated with magnesium turnings followed by concentrated hydrochloric acid. Development of pink or red colour indicated the presence of flavonoids. (Nortjie et al., 2022)



Test for Tannins

The powder blend was treated with 5% ferric chloride solution. Development of blue, green or blue-black colour indicated the presence of tannins. (Nortjie et al., 2022)

Test for Saponins

The blend was shaken vigorously with distilled water. Formation of persistent froth indicated the presence of saponins. (Nortjie et al., 2022)

Test for Steroids

The powder blend was treated with acetic anhydride followed by concentrated sulphuric acid. Development of green or bluish-green colour indicated the presence of steroids. (Nortjie et al., 2022)

Test for Glycosides

The powder blend was treated with glacial acetic acid containing ferric chloride, followed carefully by concentrated sulphuric acid. Formation of a brown ring at the interface indicated the presence of cardiac glycosides. (Nortjie et al., 2022)

Test for Carbohydrates

The powder blend was treated with Molisch's reagent followed by concentrated sulphuric acid. Formation of a violet or purple ring at the interface indicated the presence of carbohydrates. (Nortjie et al., 2022)

Compressibility index (Carr's index)

Compressibility index is used as an important parameter to determine the flow behaviour of the powder. It is indirectly related to the relative flow property rate, cohesiveness and particle size. It is simple, fast and popular method for predicting flow characteristics. Carr's index can be represented by Equation

Hausner's ratio

Hausner's ratio is used to predict the flowability of the powders. This method is similar to compressibility index. Hausner's ratio can be represented by Equation

EVALUATION OF TABLETS

All the tablets were evaluated for different parameters as thickness, hardness, friability, uniformity of weight, disintegration time, drug content and in vitro dissolution study.

Dimensional Analysis

The thickness and diameter of tablets was determined using vernier caliper. Twenty tablets from each batch were used and average values were calculated.

Hardness

The Monsanto hardness tester was used to determine the tablet hardness. The tablet was held between affixed and moving jaw. Scale was adjusted to zero; load was gradually increased until the tablet fractured.



The value of the load at that point gives a measure of the hardness of the tablet. It is expressed in kg/cm². For each formulation, the hardness of six tablets was determined and average value was calculated.

Friability

Twenty tablets samples were weighed accurately and placed in friabilator (Roche friabilator). After the given specification (4 min at 25 rpm), loose dust was removed from the tablets. Finally tablets were weighed. The loss in weight indicates the ability of the tablets to withstand this type of wear. The % friability was then calculated by

$$= \frac{[(W_{\text{avg}} - W_{\text{initial}}) / (W_{\text{avg}})] \times 100}{\text{Tablet Surface Analysis by USB Microscopy:}}$$

The Nutraceutical was examined using a USB microscope to assess particle morphology, size distribution, surface characteristics, and uniformity of mixing. The microscopic images showed relatively uniform distribution of the powder particles with no significant agglomeration.

Table 1: Formulations of polyherbal uncoated nutraceutical tablets(Per tablet weight)

Ingredients	F1
Jackfruit seed(<i>Artocarpus heterophyllus</i>) powder	100 mg
Lens culinaris(<i>Lens culinaris</i>) powder	200 mg
Microcrystalline cellulose (Grade 101)	100 mg
PVP K-30	200 mg
Fenugreek seed(<i>Trigonella foenum-graecum</i>) powder	50 mg
Kalojeera (<i>Nigella sativa</i>) powder	50 mg
Turmeric(<i>Curcuma longa</i>) powder	50 mg
Black chickpeas(<i>Cicer arietinum</i>) powder	50 mg
Magnesium Stearate	10 mg



Talc	10 mg
Myoinositol	50 mg
Aspartame	2 mg
Isopropyl Alcohol	q.s

RESULTS AND DISSCUSION

Polyherbal uncoated nutraceutical tablet were successfully prepared by Wet granulation method method using super disintegrant like PVP K-30 and varying the grades of microcrystalline cellulose,HPMC as per formulation table (Table no. 1).

Compatibility study

The FTIR spectral analysis showed that there was no change in any characteristic peaks of Natural Products and excipients, which confirmed the absence of chemical interaction between natural products and excipients. The FTIR spectra of all natural products and drug with excipients are given [figure 1(a) to 1(j) respectively].

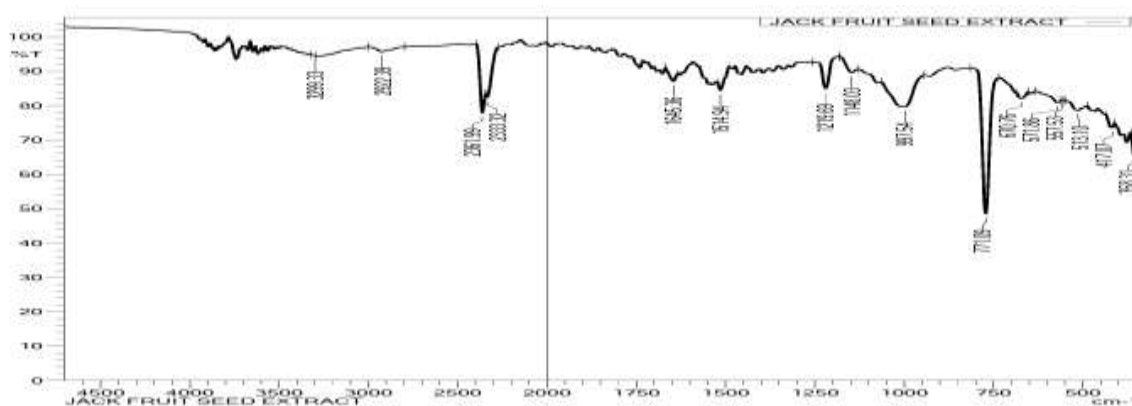


Fig. 1(a): FTIR spectra of *Artocarpus heterophyllus*

Source: Real time studies

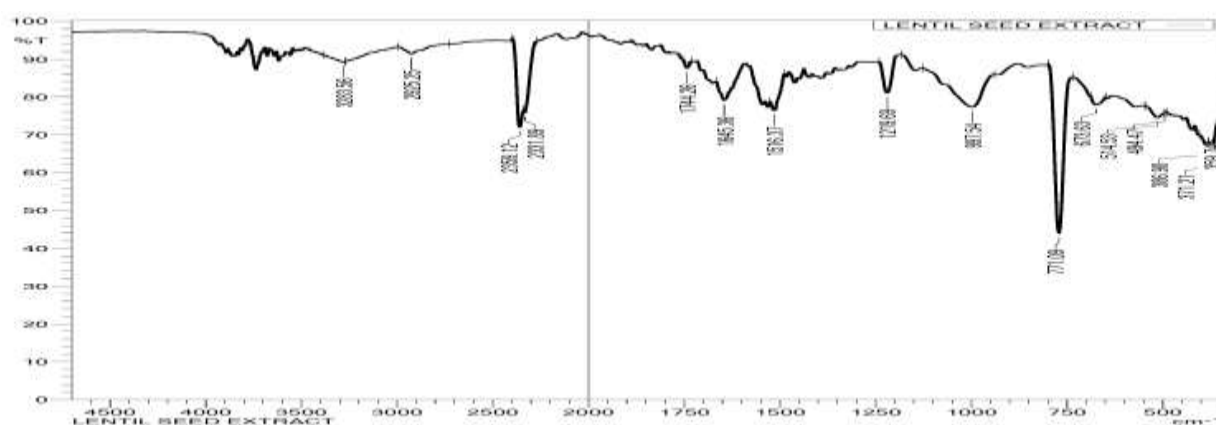


Fig. 1(b): FTIR spectra of Lens culinaris powder

Source: Real time studies

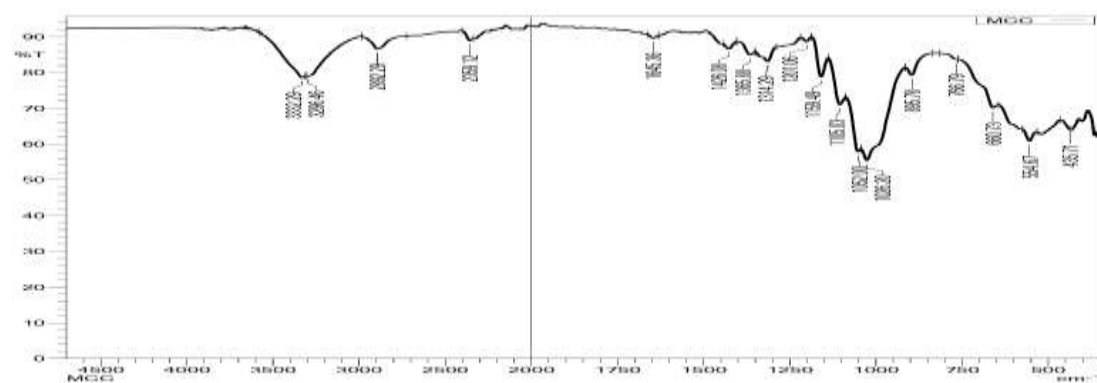


Fig.1(c): FTIR spectra of Microcrystalline Avicel Ph 101

Source: Real time studies

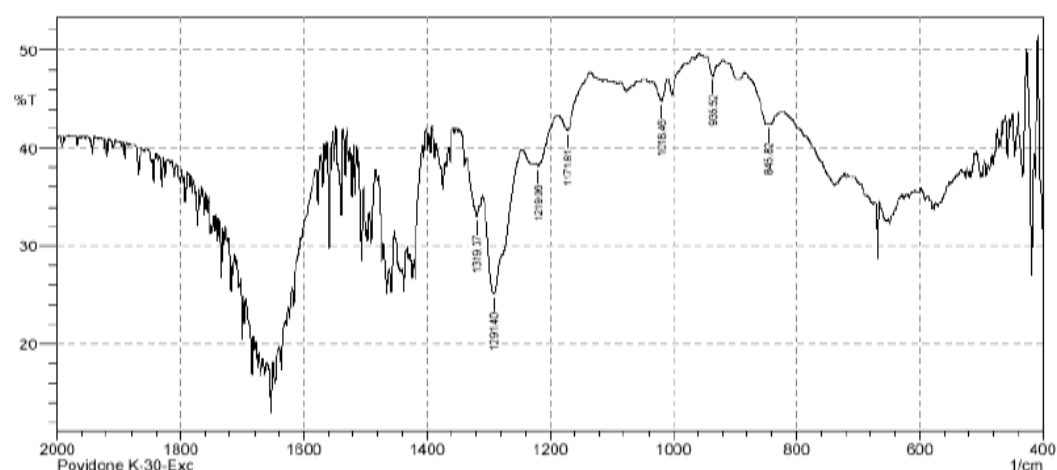


Fig. 1(d); FTIR Spectra of PVP K-30

Source: Real time studies



Fig. 1(e): FTIR spectra of *Trigonella foenum-graecum* powder

Source: Real time studies

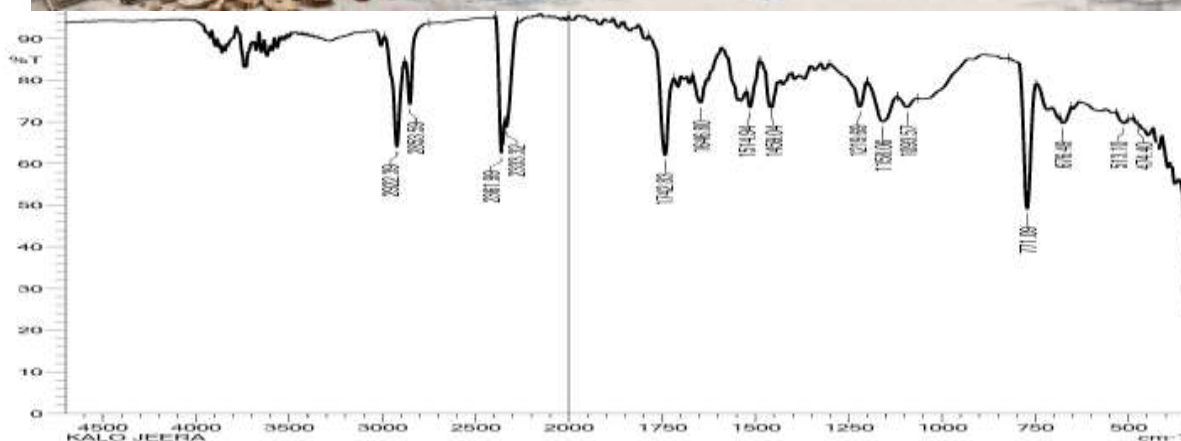


Fig 1(f): FTIR spectra of Nigella sativa powder

Source: Real time studies

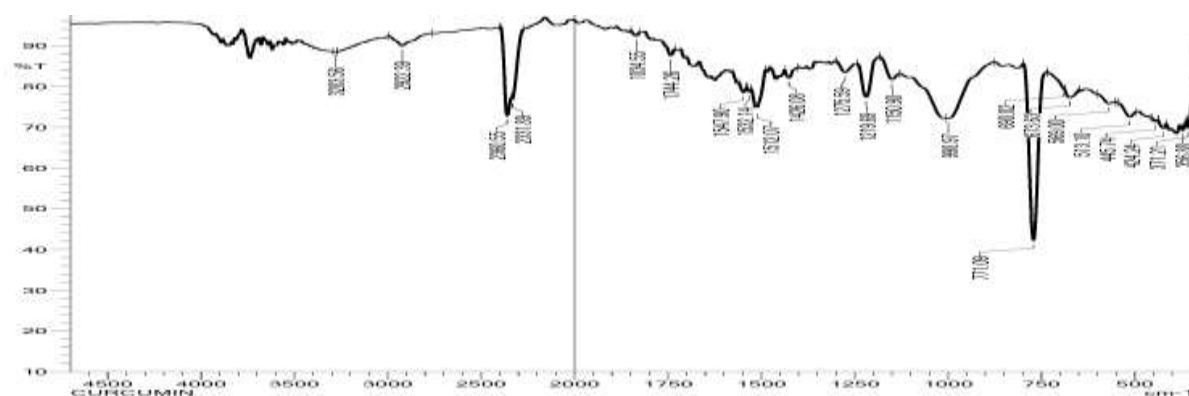


Fig.1(g): FTIR spectra of Curcuma longa powder

Source: Real time studies



Fig. 1(h): FTIR spectra of *Cicer arietinum* powder

Source: Real time studies

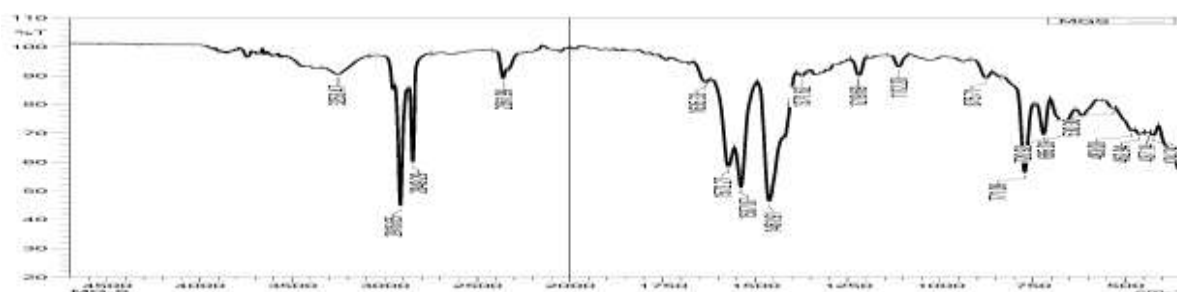


Fig. 1(i): FTIR spectra of Magnesium Stearate

Source: Real time studies

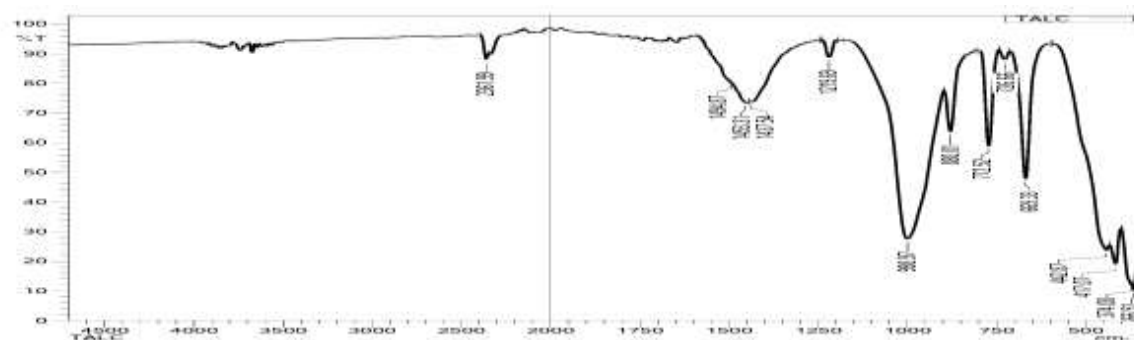


Fig. 1(j): FTIR spectra of Talc



Source: Real time studies

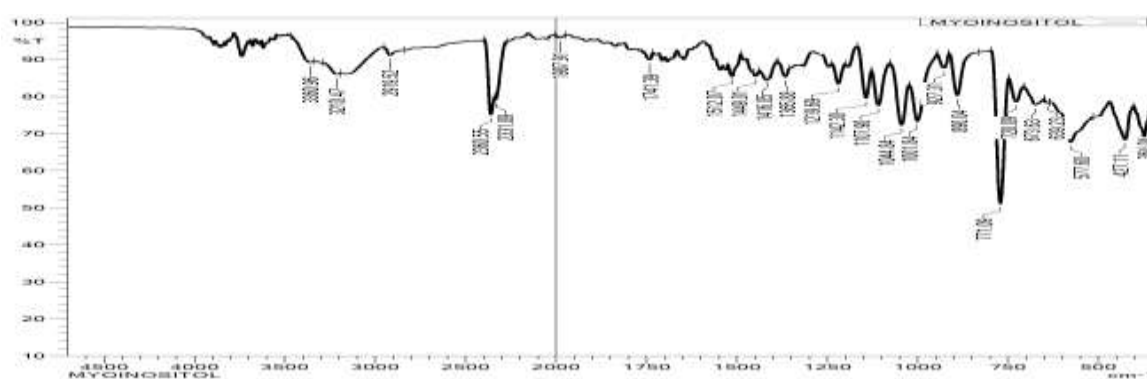


Fig 1(k) : FTIR Spectra of Myoinositol

Source: Real time studies

Particle Size Analysis of Powder Blend

Particle size distribution of the powder blend was determined using a standard sieve shaker. The blend was passed through sieves of different apertures, and the weight retained on each sieve was recorded. The calculated mean particle size of the powder blend was 540.19 μm (approximately 0.54 mm), indicating a predominantly fine-to-moderate particle size suitable for further formulation processing as per table no. 2

Table No. 2 Particle Size Determination

Sieve	Apperture Size (μm)	Weight Retained	% Retained
#20	850	5.431 gm	38.92
#30	600	3.863 gm	8.81
#44	355	3.430 gm	24.58



#60	250	1.230 gm	27.68
		Total- 13.954 gm	

Mean particle size $\approx 540.19 \mu\text{m}$

Graphical Interpretation from FTIR Spectra

Sample	Major FTIR Peaks (cm^{-1})	Functional Group Assignment
Artocarpus heterophyllus extract	3293, 2922, 1645, 1514, 1219, 1148, 978, 771	O–H/N–H, C–H, C=O/C=C, aromatic C=C, C–O, C–O–C, aromatic C–H
Lens culinaris extract	3289, 2923, 1744, 1625, 1516, 1219, 987, 771	O–H/N–H, C–H, C=O, amide/C=C, aromatic C=C, C–O, C–H
Microcrystalline cellulose (Grade101)	3330, 2929, 2859, 1645, 1538, 1450, 1370, 1310,	O–H, C–H, C=O/bound water, C–O, C–O–C, C–H bending



	1100–1025	
Povinyl Pyrollidienne K-30	1650, 1420, 1280–1300, 1100–1000	Lactam C=O, CH ₂ bending, C–N, C–O/C–N
<i>Trigonella foenum- graecum</i> Seed Powder	3400, 2947, 2856, 1745– 1653, 1510, 1436–1319, 1246–1050, 960–690	O–H/N–H, C–H, C=O, C=C, C–O/C–N, C– O–C, Si–O/Si–O–Si
<i>Nigella sativa</i> powder	2922, 2854, 1743, ~1630, ~1515, ~1450, ~1260, ~1168, ~1080–1035, 771	C–H, C=O, C=C, aromatic C=C, CH ₂ bending, C–O, C–O–C, C–H
<i>Curcuma longa</i>	~3500, 2922, 2854, 1628, ~1510, ~1430,	O–H, C–H, conjugated C=O/C=C, aromatic C=C, C–O, C–O–C



	1275, 1160– 1030	
Cicer arietinum Powder	~3294, 2922, 2855, ~1744, ~1630, 1512, 1450, 1219, 1168, 1035	O–H/N–H, C–H, C=O, C=C, aromatic C=C, C–O, C–O–C
Magnesium Stearate	~3360, 2915, 2850, ~1575, ~1465, ~1400, ~1300–1030, ~720	O–H, C–H, carboxylate-related groups, CH ₂ bending, C–O
Talc	2632, 1495, 1454, 1219, 999, 727, 680– 660, 447–410	Si–O, Si–O–Si, Mg–O/silicate lattice vibrations
Myoinisitol	3369, 2915, 2605, 1743, 1450, 1045, 741	O–H, C–H, C–O, C–H bending, fingerprint vibrations

Table no. 3 Graphical interpretation from FTIR spectra



Graph overlay of the entire blend in terms of IR-Spectrum

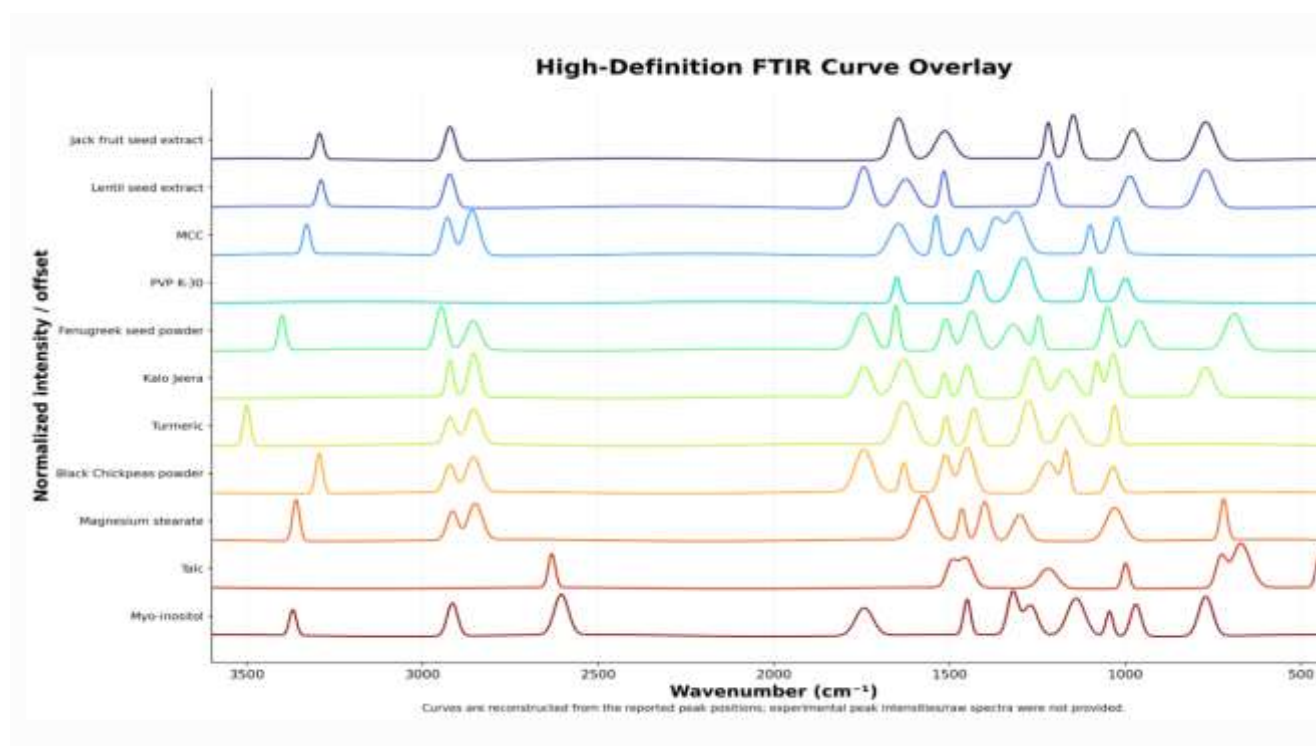


Figure 2. High Definition FTIR curve overlay

Source : Authors own deduction based on real time study

Observation from graph overlay

FTIR analysis indicated the presence of overlapping characteristic functional groups among the formulation components, particularly in the O–H/N–H, C=O/C=C and C–O regions. The observed overlap suggests the possibility of intermolecular hydrogen bonding, particularly between the phytoconstituents and polar excipients such as MCC and PVP K-30. However, definitive confirmation of chemical interaction requires comparison of the individual components with the physical mixture and optimized formulation spectra, including evaluation of characteristic peak shifts, disappearance or emergence of new bands, and changes in band intensity.

Mass -volume relationship

The characterizations of different formulation were done for determination of mass-volume



relationship parameters.

Flow properties

The bulk density of the powder was in the range of 0.56-to 0.60gm/ml; the tapped density was in the range of 0.79 to 0.88gm/ml, which indicates that the powder was not bulky. The angle of repose of the formulations was in the range of 30° to 36.35° which indicated good flow of the powder. The Carr's index was found to be in the range of 28 to 30.83 with the formulations containing MCC 101 , Talc, Magnesium Stearate , PVP-K30 indicating poor compressibility of the tablet blend. The evaluated parameters are bulk density, tapped density, compressibility index, and angle of repose, Carr's index were shown in table 3.

Table 3: Evaluation of Powder Blend

Total No. of Observation	Bulk Density (gm/ml)	Tapped Density (gm/ml)	Angle of Repose (θ)	Carr's Compressibility Index	Hausner's Ratio
1	0.566	0.7925	30.76	28.50	1.40027
2	0.609	0.812	36.35	25	1.3333
3	0.609	0.8805	36	30.83	1.4458

Table 4: Evaluation of Neutracutical Tablets

Total No. of Observation	Hardness (kg/cm ²)	Friability (%)	Weight Variation (mg)	Thickness (cm)	Disintegration time (sec)
1	5	0.75	901	12.17	300
2	6.5	0.35	921	12.10	420
3	6.4	0.47	917	10.10	300



Tablet Thickness

Thickness of the formulation varied from 12.10 to 12.17 mm.

Friability Test

The tablets are well passed in the given test and passed as per U.S.P Limit (less than 1 %).

Weight Variation test :

The tablets were passed in the weight variation test properly.

Disintegration test :

Tablets from each batch show immediate disintegration. Disintegration time varied between 250 to 300 seconds.

Hardness :

The hardness of the given tablet was in the range 5 to 6.4 kg/cm²

Tablet Surface Analysis by USB Microscopy:

USB microscopy can be used as a simple morphological assessment of the prepared tablets. The tablet surface is examined under suitable magnification to evaluate surface uniformity, texture, cracks, pores, pits, granule distribution, and the presence of visible surface defects. Images are captured from representative regions of the tablet surface and compared between formulations. A relatively smooth and homogeneous surface with minimal cracks and pores indicates satisfactory compaction and uniform distribution of the tablet constituents.

The Frontal, Cross Sectional and Basolateral view of Tablet was examined using USB Microscopy. All the images are given from Figure 3(a) to Figure 3(c).



Figure 3.(a) Microscopic image of Cross section of tablets at 1000x



Source :Real time studies



Figure 3.(b) Frontal view of tablet

Source :Real time studies



Figure 3.(c) Lateral view of tablet

Source :Real time studies



Ingredients	Glycoside Test	Saponin Test	Alkaloid Test	Flavonoid Test	Molisch Test	Steroid Test	Tanin Test
Artocarpus heterophyllus Powder	+	-	-	+	-	+	-
Lens culinaris Powder	-	+	-	+	-	+	-
Trigonella foenum-graecum Seed Powder	+	+	+	-	-	+	+
Nigella Sativa Powder	+	+	+	-	-	+	-
Curcuma longa Powder	+	-	+	-	-	+	+
Cicer arietinum Powder	+	+	-	+	-	+	+
Myo Inositol	-	+	+	-	-	+	-
Powder Blend	-	+	+	+	-	+	-

Table No. 5 Pharmacognostic screening test for herbal materials

Conflict of Interest

The authors declare that there is no conflict of interest related to this research.

Conclusion

The present study successfully demonstrated the formulation and preliminary evaluation of a polyherbal uncoated nutraceutical tablet for the management of PCMS using jackfruit seed powder, Lens culinaris powder, fenugreek, Nigella sativa, turmeric, and black chickpea as the major natural components. The ingredients were subjected to preliminary processing, size reduction, sieving, blending, and wet granulation using PVP K-30, followed by lubrication with talc and magnesium stearate and compression into tablets.

The powder blend showed a mean particle size of approximately 540.19 μm , with satisfactory bulk and tapped density characteristics. The prepared granules exhibited acceptable flow characteristics, while the pharmacognostic screening demonstrated the presence of several phytochemical constituents, particularly alkaloids, flavonoids, glycosides, saponins and tannins in different natural ingredients and in the final powder blend.



References

1. Ahmad, A., Husain, A., Mujeeb, M., Khan, S. A., Najmi, A. K., Siddique, N. A., Damanhour, Z. A., & Anwar, F. (2013). A review on therapeutic potential of *Nigella sativa*: A miracle herb. *Asian Pacific Journal of Tropical Biomedicine*, 3(5), 337–352.
2. Ahmad, A., Mishra, R. K., Vyawahare, A., Kumar, A., Rehman, M. U., Qamar, W., Khan, R., & Ahmad, M. (2019). Thymoquinone, a constituent of *Nigella sativa*, as a potential therapeutic agent. *Phytotherapy Research*, 33, 653–665.
3. Alu'datt, M. H., Rababah, T., Al-Ali, S., Tranchant, C. C., Gammoh, S., Alrosan, M., Kubow, S., Tan, T.-C., & Ghatasheh, S. (2024). Current perspectives on fenugreek bioactive compounds and their potential impact on human health: A review of recent insights into functional foods and other high value applications. *Journal of Food Science*, 89(4), 1835–1864. <https://doi.org/10.1111/1750-3841.16970>
4. Azziz, R., Carmina, E., Chen, Z., Dunaif, A., Laven, J. S. E., Legro, R. S., Lizneva, D., Natterson-Horowitz, B., Teede, H. J., & Yildiz, B. O. (2016). Polycystic ovary syndrome. *Nature Reviews Disease Primers*, 2, 16057. <https://doi.org/10.1038/nrdp.2016.57>
5. Baliga, M. S., Shivashankara, A. R., Haniadka, R., Dsouza, J., & Bhat, H. P. (2011). Phytochemistry, nutritional and pharmacological properties of *Artocarpus heterophyllus* Lam. (jackfruit): A review. *Food Research International*.
6. Bamasa, A. O., Ali, B. A., & Sowayan, S. A. (1997). Effect of oral ingestion of *Nigella sativa* seeds on some blood parameters. *Saudi Pharmaceutical Journal*, 5, 126–129.
7. Basch, E., Ulbricht, C., Kuo, G., Szapary, P., & Smith, M. (2003). Therapeutic applications of fenugreek. *Alternative Medicine Review*, 8, 20–27.
8. Bashtian, M., et al. (2012). Effects of fenugreek supplementation on metabolic and reproductive parameters in women with polycystic ovary syndrome. *Phytotherapy Research*.
9. Bashtian, M., et al. (2012). Evaluation of the effect of fenugreek on polycystic ovary syndrome. *Phytotherapy Research*.
10. Bozdog, G., Mumusoglu, S., Zengin, D., Karabulut, E., & Yildiz, B. O. (2016). The prevalence and phenotypic features of polycystic ovary syndrome: A systematic review and meta-analysis. *Human Reproduction*, 31(12), 2841–2855.
11. Chatterjee, G., Saha, A. K., Khurshid, S., & Saha, A. (2025). A comprehensive review of the antioxidant, antimicrobial, and therapeutic efficacies of black cumin (*Nigella sativa* L.) seed oil and



- its thymoquinone. *Journal of Medicinal Food*, 28(4), 325–339.
<https://doi.org/10.1089/jmf.2024.k.0149>
12. Chien, Y. J., Chang, C. Y., Wu, M. Y., Chen, C. H., Horng, H. C., Wu, H. C., Wang, P. H., & Wen, K. C. (2021). Effects of curcumin on glycemic control and lipid profile in polycystic ovary syndrome: Systematic review with meta-analysis and trial sequential analysis. *Nutrients*, 13(2), 684.
<https://doi.org/10.3390/nu13020684>
 13. Croze, M. L., & Soulage, C. O. (2013). Potential role and therapeutic interests of myo-inositol in metabolic diseases. *Biochimie*, 95(10), 1811–1827.
 14. Ehrmann, D. A. (2005). Polycystic ovary syndrome. *New England Journal of Medicine*, 352(12), 1223–1236.
 15. Fitz, V., Graca, S., Mahalingaiah, S., Liu, J., Lai, L., Butt, A., Armour, M., Rao, V., Naidoo, D., Maunder, A., Yang, G., Vaddiparthi, V., Witchel, S. F., Pena, A., Spritzer, P. M., Li, R., Tay, C., Mousa, A., Teede, H., & Ee, C. (2024). Inositol for polycystic ovary syndrome: A systematic review and meta-analysis to inform the 2023 update of the International Evidence-based PCOS Guidelines. *Journal of Clinical Endocrinology & Metabolism*, 109(6), 1630–1655.
<https://doi.org/10.1210/clinem/dgad762>
 16. Forouzanfar, F., Bazzaz, B. S. F., & Hosseinzadeh, H. (2014). Black cumin (*Nigella sativa*) and its constituent thymoquinone: A review on antimicrobial effects. *Iranian Journal of Basic Medical Sciences*, 17, 929–934.
 17. Franks, S. (1995). Polycystic ovary syndrome. *New England Journal of Medicine*, 333(13), 853–861.
 18. Gerli, S., Mignosa, M., & Di Renzo, G. C. (2003). Effects of inositol on ovarian function and metabolic factors in women with PCMS. *European Review for Medical and Pharmacological Sciences*, 7, 151–159.
 19. Gholamnezhad, Z., Havakhah, S., & Boskabady, M. H. (2016). Preclinical and clinical effects of *Nigella sativa* and its constituent thymoquinone on respiratory diseases. *Fundamental & Clinical Pharmacology*, 30, 147–158.
 20. Goel, A., Kunnumakkara, A. B., & Aggarwal, B. B. (2008). Curcumin as “Curecumin”: From kitchen to clinic. *Biochemical Pharmacology*, 75, 787–809.
 21. Gupta, S. C., Patchva, S., & Aggarwal, B. B. (2013). Therapeutic roles of curcumin: Lessons learned from clinical trials. *The AAPS Journal*, 15, 195–218.
 22. Gupta, S. C., Sung, B., Kim, J. H., Prasad, S., Li, S., & Aggarwal, B. B. (2013). Multitargeting by turmeric, the golden spice: From kitchen to clinic. *Molecular Nutrition & Food Research*, 57, 1510–1528.
 23. Hannan, M. A., Rahman, M. A., Sohag, A. A. M., Uddin, M. J., Dash, R., Sikder, M. H., Rahman,



- M. S., Timalisina, B., Munni, Y. A., Sarker, P. P., & Kim, B. (2021). Black cumin (*Nigella sativa* L.): A comprehensive review on phytochemistry, health benefits, molecular pharmacology, and safety. *Nutrients*, 13, 1784.
24. Haroon, S., et al. (2022). Complementary administration of curcumin in PCMS: A systematic review. *Journal of Complementary and Integrative Medicine*, 19.
 25. Hewlings, S. J., & Kalman, D. S. (2017). Curcumin: A review of its effects on human health. *Foods*, 6(10), 92.
 26. Hewlings, S. J., & Kalman, D. S. (2017). Curcumin and its effects on inflammation and metabolic health. *Nutrients*, 9, 101.
 27. Jagtap, U. B., Panaskar, S. N., & Bapat, V. A. (2010). Evaluation of antioxidant capacity and phenol content in jackfruit fruit pulp. *Plant Foods for Human Nutrition*, 65, 99–104.
 28. Joham, A. E., Boyle, J. A., Ranasinha, S., Zoungas, S., & Teede, H. J. (2015). Contraception use, fertility and pregnancy in women with polycystic ovary syndrome. *Human Reproduction Update*, 21(5), 559–574.
 29. Joe, B., Vijaykumar, M., & Lokesh, B. R. (2004). Biological properties of curcumin-cellular and molecular mechanisms of action. *Critical Reviews in Food Science and Nutrition*, 44, 97–111.
 30. Kawa, J. M., Przybylski, R., & Taylor, C. G. (2003). Buckwheat extract reduces serum cholesterol in rats. *Canadian Journal of Physiology and Pharmacology*, 81, 22–27.
 31. Kunnumakkara, A. B., Bordoloi, D., Padmavathi, G., Monisha, J., Roy, N. K., Prasad, S., & Aggarwal, B. B. (2017). Curcumin, the golden nutraceutical: Multitargeting for multiple chronic diseases. *British Journal of Pharmacology*, 174(11), 1325–1348.
 32. Lalruatdiki, H., Mishra, H., Lalchhandama, C., Laltlankimi, R., Shevkani, K., & Sharma, P. (2026). An overview on nutritional composition, bioactive constituents, health benefits, and food applications of jackfruit (*Artocarpus heterophyllus*) seeds. *Discover Food*, 6, 216. <https://doi.org/10.1007/s44187-026-00945-6>
 33. Legro, R. S., Arslanian, S. A., Ehrmann, D. A., Hoeger, K. M., Murad, M. H., Pasquali, R., & Welt, C. K. (2013). Diagnosis and treatment of polycystic ovary syndrome. *Journal of Clinical Endocrinology & Metabolism*, 98(12), 4565–4592.
 34. Li, R.-L., Zhang, Q., Liu, J., He, L.-Y., Huang, Q.-W., Peng, W., & Wu, C.-J. (2021). Processing methods and mechanisms for alkaloid-rich Chinese herbal medicines: A review. *Journal of Integrative Medicine*, 19(2), 89–103.
 35. Lizneva, D., Suturina, L., Walker, W., Brakta, S., Gavrilova-Jordan, L., & Azziz, R. (2016). Criteria, prevalence, and phenotypes of polycystic ovary syndrome. *Fertility and Sterility*, 106(1), 6–15.
 36. March, W. A., Moore, V. M., Willson, K. J., Phillips, D. I. W., Norman, R. J., & Davies, M. J. (2010).



- The prevalence of polycystic metabolic syndrome in a community sample assessed under contrasting diagnostic criteria. *Human Reproduction*, 25(2), 544–551.
37. Meghwal, M., & Goswami, T. K. (2012). A review on the functional properties, nutritional content, medicinal utilization and potential application of fenugreek. *Journal of Food Processing & Technology*, 3, 181.
 38. Menon, V. P., & Sudheer, A. R. (2007). Antioxidant and anti-inflammatory properties of curcumin. *Advances in Experimental Medicine and Biology*, 595, 105–125.
 39. Nestler, J. E., & Unfer, V. (2015). Reflections on inositol(s) for PCMS therapy. *International Journal of Endocrinology*, 2015.
 40. Norman, R. J., Dewailly, D., Legro, R. S., & Hickey, T. E. (2007). Polycystic ovary syndrome. *The Lancet*, 370(9588), 685–697.
 41. Nortjie, E., Basitere, M., Moyo, D., & Nyamukamba, P. (2022). Extraction methods, quantitative and qualitative phytochemical screening of medicinal plants for antimicrobial textiles: A review. *Plants*, 11(15), 2011. <https://doi.org/10.3390/plants11152011>
 42. Papaleo, E., Unfer, V., Baillargeon, J. P., Fusi, F., & De Santis, L. (2007). Myo-inositol may improve oocyte quality in intracytoplasmic sperm injection cycles. *Fertility and Sterility*, 88(3), 702–705.
 43. Prakash, O., Kumar, R., Mishra, A., & Gupta, R. (2009). *Artocarpus heterophyllus* (jackfruit): An overview. *Pharmacognosy Reviews*, 3, 353–358.
 44. Prasad, S., Gupta, S. C., Tyagi, A. K., & Aggarwal, B. B. (2014). Curcumin, a component of golden spice: From bedside to bench and back. *Biotechnology Advances*, 32(6), 1053–1064.
 45. Pundir, J., Charlesworth, G., Sabatini, L., Huirne, J. A. F., Starc, A., & Teede, H. (2018). Inositol treatment of anovulation in women with polycystic ovary syndrome: A meta-analysis of randomised trials. *BJOG*, 125(3), 299–308.
 46. Ranasinghe, R. A. S. N., Maduwanthi, S. D. T., & Marapana, R. A. U. J. (2019). Nutritional and health benefits of jackfruit. *International Journal of Food Science*, 2019, 4327183.
 47. Roberts, K. T. (2011). The potential of fenugreek (*Trigonella foenum-graecum*) as a functional food and nutraceutical. *Phytotherapy Research*, 25, 557–568.
 48. Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. (2004). Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. *Human Reproduction*, 19(1), 41–47.
 49. Sauvaire, Y., Ribes, G., Baccou, J. C., & Loubatieres-Mariani, M. M. (1991). Implication of steroid saponins and sapogenins in the hypocholesterolemic effect of fenugreek. *Lipids*, 26, 333–340.
 50. Saxena, A., Bawa, A. S., & Raju, P. S. (2011). Phytochemical and antioxidant activity of jackfruit seed. *Food Chemistry*, 125, 215–220.



51. Shen, W., Qu, Y., Jiang, H., Wang, H., Pan, Y., Zhang, Y., Wu, X., Han, Y., & Zhang, Y. (2022). Therapeutic effect and safety of curcumin in women with PCMS: A systematic review and meta-analysis. *Frontiers in Endocrinology*, 13, 1051111. <https://doi.org/10.3389/fendo.2022.1051111>
52. Showell, M. G., Mackenzie-Proctor, R., Jordan, V., Hart, R. J., Farquhar, C., & Brown, J. (2018). Inositol for subfertile women with polycystic ovary syndrome. *Cochrane Database of Systematic Reviews*, 12, CD012378.
53. Simental-Mendía, L. E., Shah, N., Sathyapalan, T., Majeed, M., Orekhov, A. N., Jamialahmadi, T., & Sahebkar, A. (2022). Effect of curcumin on glycaemic and lipid parameters in polycystic ovary syndrome: A systematic review and meta-analysis of randomized controlled trials. *Endocrine*, 76, 1–10.
54. Somase, S., Gayke, A., Sangale, S., & Jadhav, S. (2025). Jackfruit seed as a source of natural bioactives: A review on its therapeutic potentials. *International Journal of Pharmaceutical Sciences*.
55. Srinivasan, K. (2005). Plant foods in the management of diabetes mellitus: Spices as beneficial antidiabetic food adjuncts. *International Journal of Food Sciences and Nutrition*, 56, 399–414.
56. Srinivasan, K. (2006). Fenugreek (*Trigonella foenum-graecum*): A review of health beneficial physiological effects. *Food Reviews International*, 22, 203–224.
57. Swami, S. B., Thakor, N. J., Haldankar, P. M., & Kalse, S. B. (2012). Jackfruit and its many functional components as related to human health: A review. *Comprehensive Reviews in Food Science and Food Safety*, 11, 565–576.
58. Tavakkoli, A., Ahmadi, A., Razavi, B. M., & Hosseinzadeh, H. (2017). Black seed (*Nigella sativa*) and its constituent thymoquinone as an antidote or a protective agent against natural or chemical toxicities. *Iranian Journal of Basic Medical Sciences*, 20, 1079–1090.
59. Teede, H. J., Tay, C. T., Laven, J. S. E., Dokras, A., Moran, L. J., Piltonen, T., Costello, M. F., Boivin, J., Redman, L. M., Boyle, J. A., Norman, R. J., Mousa, A., Joham, A. E., & International PCMS Network. (2023). Recommendations from the 2023 international evidence-based guideline for the assessment and management of polycystic ovary syndrome. *European Journal of Endocrinology*, 189(2), G43–G64. <https://doi.org/10.1093/ejendo/lvad096>
60. Unfer, V., Carlomagno, G., Dante, G., & Facchinetti, F. (2012). Effects of myo-inositol in women with PCMS: A systematic review of randomized controlled trials. *Gynecological Endocrinology*, 28(7), 509–515.
61. Unfer, V., Nestler, J. E., Kamenov, Z. A., Prapas, N., & Facchinetti, F. (2016). Effects of inositol(s) in women with PCMS: A systematic review of randomized controlled trials. *International Journal of Endocrinology*, 2016, 1849162. <https://doi.org/10.1155/2016/1849162>
62. Wani, S. A., & Kumar, P. (2018). Fenugreek: A review on its nutraceutical properties and



- applications. *Journal of the Saudi Society of Agricultural Sciences*, 17, 97–106.
63. Woo, C. C., Kumar, A. P., Sethi, G., & Tan, K. H. (2012). Thymoquinone: Potential cure for inflammatory disorders and cancer. *Biochemical Pharmacology*, 83, 443–451.
64. Yadav, U. C. S., Moorthy, K., & Baquer, N. Z. (2004). Effects of sodium-orthovanadate and fenugreek seed powder on insulin signaling in diabetic rats. *Diabetes, Obesity and Metabolism*, 6, 278–287.