Research Article

Formulation and Development of Pumpkin Seeds (*Cucurbita pepo*) Nutraceuticals

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ABSTRACT

The term nutraceutical derived from two words that are nutrition and pharmaceutical. It is a combination of food and pharmaceutical. Nutraceuticals help us in avoiding specific medical issues as well as taking care of oneself, thus having a psychological advantage. It May appear more "natural" and less likely to cause unpleasant side effects than orthodox treatment. Food for populations with special requirements (such as nutrient-dense diets for the elderly) may be offered. Nutraceuticals are mainly of two types of potential and established. Potential nutraceuticals are those nutraceuticals which exhibit a great promising result in terms of recovering from specific health or medical condition, whereas to become an established nutraceutical, its advantages must be proven and supported by clinical research. In this research Pumpkin seeds (Cucurbita pepo) stand out as a prospective choice due to their high phytochemical content, nutritional richness, and therapeutic efficiency. In addition to their traditional usage as medicine in many cultures, pumpkin seeds are also undergoing scientific evaluation for their potential to improve health. Essential fatty acids, proteins, dietary Fiber, and important micronutrients like iron, and zinc are all rich in them. Their strong anti-inflammatory and antioxidant qualities are also attributed to the presence of bioactive substances. Pumpkin seeds have the potential to treat BPH (benign prostatic hyperplasia), LUTS (Lower urinary tract symptoms). This research work was carried out to formulate a suitable dosage form for administration for elderly people, and this formulation would carry out as supplementation.

Keywords: Nutraceuticals, potential nutraceuticals, Cucurbita pepo, BPH, LUTS.

INTRODUCTION

Nutraceuticals are described as 'specially designed preparations', prepared with the intention of satisfying individual specific dietary needs and/or provide preventive health care. Nutraceuticals are the preparation of nutrient/nutrients which aid in the prevention and treatment of certain diseases, along with a supplement diet. Nutraceutical is a word coined by Dr. Stephen De Felice in 1989 and derived from two words "nutrition" and "pharmaceutical".[1-2]

They are foods or portion of foods that play a useful role in offering a number of health benefits such as the prevention and/or cure of the disease. The market for plant nutraceuticals has grown exponentially with expanded interest in holistic and preventative medicine globally, which has driven research on under-exploited yet high-impact natural resources. Nutraceuticals are derived from plant or animal food, and such research on their safety, mode of action, and clinical evidence has been carried out across the globe.

These are the therapeutic interventions, for example, type 2 diabetes, stroke, coronary heart disease, and heart disease, that can prevent a cluster of disorders that often occur together (metabolic syndrome) but are not presenting itself as an alternative to drugs. Nutraceuticals pose the threat of prevention and cure in the years to come and are a driving force within the realm of medicine. In non-candidates for pharmacological treatment, the capacity to forestall or support pharmacological treatment—which today is largely pharma-dependent—can become a strong tool to treat pathological, chronic, and long-lasting disorders.[3-5]

Nutrition is an important function in sustaining good health and preventing illness. In recent years, nutraceuticals have been of increasing interest. These are food-derived products that are supposed to serve additional functions in promoting health beyond that provided by normal nutrition. Most of these products are sold as dietary supplements and are claimed to prevent chronic diseases, enhance general health, delay the aging process, elongate life, and maintain the body structure and function.[6]

Pumpkin (Cucurbita) belongs to the family Cucurbitaceae generally grown in the regions of the globe as a vegetable. These are grown-up in the tropical and sub-tropical regions and including the cucumbers and squash. Worldwide there are three types of the pumpkins are present name as "Cucurbita pepo", "Cucurbita maxima" and "Cucurbita moschata".

Nutraceutical importance of pumpkin seed: The physical properties, chemical composition and fatty acid proportion was determined by an investigator and his collogues they found that pumpkin seeds contained 41.59% oil, 25.4% protein, 5.2 % Moisture, 25.19% carbohydrates, 5.34% fiber, and 2.49% total ash. Total phenolic compounds, total sterols, waxes and total tocopherols were 66.25 (mg galic acid per kg oil), 1.86%, 1.56% and 882.65 (mg tocopherol per kg oil) respectively Ardabili.[7-13.]

This study aims at the design and systematic assessment of Pumpkin seed formulation such as capsules and suspension for improving its administration. A set of batches (F1-F5) of

capsules and (F1-F4) of Suspension are formulated and evaluated to examine the efficiency of the formulations.

MATERIALS AND METHODS

Materials

Pumpkin seed was produced by, Hydroxypropyl methylcellulose (HPMC, E5 LV PREMIUM) was procured from Research-Lab Fine Chem Industries (CAS No: 9004-65-3). Microcrystalline cellulose (MCC) was procured from Research-Lab Fine Chem Industries. Croscarmellose sodium (CCS). Ethanol was supplied by Changshu Hongsheng Fine Chemical Co. Ltd. Ethyl cellulose was manufactured by, sodium benzoate was produced by nice chemical(P) ltd. Talc was produced by Loba chemie, and Magnesium stearate (Mgs) were produced by Research-Lab Fine Chem Industries.

Methods of preparation:

For preparation of Capsules:

First blend the pumpkin seeds by blender to make fine powder. then add slowly HPMC E 5 LV Premium (For F1, F3,) and Ethyl cellulose (For F2, F4,) Binder was mix well. The excipients were weighed and then sieved by sieve no.40 and mixed with the pumpkin seed powder. The ingredients were then charged with alcohol to make a soft dough. This soft dough was then sieved through sieve no 18 to form granules. The moisture content of the prepared granules was then reduced to 2.35%. These granules were then compressed to form tablets using rotary press. The prepared tablets were further granulated to and then filled into capsule shells to increase their flow properties. The formulation table for capsules is mentioned in table 2

For preparation of Suspension:

At first Pumpkin Seeds were weighed accurately and grinded to form a powder. This was then sieved through a sieve of pore size no. 44. Then HPMC E 5 LV Premium (For F1, F2,) and Sodium CMC (For F3) added to a mortar Prestel with the pumpkin seed and triturate it properly. After that Sodium Benzoate was added as a preservative to it as well as Stevia and Cocoa powder was added as flavouring agent and then the entire powder mixture was further triturated. Then in a separated beaker the oily vehicle was prepared by taking 200ml of Olive Oil and 10ml of Avocado Oil. Here in the formulation the dispersed phase and dispersion medium was taken in the ration of 1:2. Then this oil mixture was slowly added to the powder mix and blended well to form a uniform dispersion. After that the suspension form by added the rest oil phase to add to the rest of the volume. Once the suspension is made, the formulation is transferred to a beaker and tween 80 as added to it and the formulation was stabilized. In this last step, the product's performance, consistency, and quality are evaluated. Evaluation helps to guarantee that the product is appropriate for the intended purpose by verifying that it meets the relevant standards and regulations. The formulation table for suspension is mentioned in table 3.

Preformulation Studies

1. **Bulk density**

   Bulk density is the mass of a powder divided by the total volume it occupies, which includes the volume of the particles themselves and the void spaces between them.

2. **Tapped density**

   Tapped Density is the density a powder achieves after being subjected to a standardized tapping or mechanical vibration process, which compacts the powder and reduces the void spaces between particles.

3. **Angle of repose**

   It is the maximum angle formed between the surface of a pile of a free-flowing powder or granule and the horizontal plane. It helps in determining the flow behavior of the formulation.

Moisture Content

Moisture content is the amount of water present in a pharmaceutical formulation. It is either water absorbed on the surface or water bound within the formulation.it is expressed in % and was recorded using a moisture balance.

Table 1: Preformulation Studies

Parameters	F1	F2	F3	F4
Tapped density	0.59 g\ml	0.45 g/ml	0.43g/ml	0.40g/ml
Bulk density	0.486g/ml	0.472 g/ml	0.34g/ml	0.442g/ml
Angle of repose	30.96°	26.50°	31.26°	29.44°
Moisture content (%)	2.35	4.14	3.93	4.09
Sieve analysis	8 OVERSIZED= 1.05% 14 OVERSIZED= 1.46% 16 OVERSIZED= 3.88% 18 OVERSIZED= 2.21% 24 OVERSIZED= 17.52% 30 OVERSIZED= 20.69% FINES= 29.88%	8 OVERSIZED= 1.36% 14 OVERSIZED= 8.50% 16 OVERSIZED= 6.08% 18 OVERSIZED= 8.11% 24 OVERSIZED= 7.24% 30 OVERSIZED= 32.03% FINES= 42.64%	8 OVERSIZED= 1.03% 14 OVERSIZED= 1.4% 16 OVERSIZED= 3.7% 18 OVERSIZED= 2.2% 24 OVERSIZED= 16.4% 30 OVERSIZED= 30.6% FINES= 26%	8 OVERSIZED= 1.5% 14 OVERSIZED= 2.3% 16 OVERSIZED= 3.7% 18 OVERSIZED= 2.5% 24 OVERSIZED= 16.4% 30 OVERSIZED= 32.5% FINES= 28%

Table 2: Formulation table for capsules

Ingredients	F1	F2	F3	F4
Pumpkin Seed (g)	75gm	20gm	75gm	20gm
HPMC (g)	10gm	-	-	50gm
Ethyl cellulose (g)	-	5gm	10gm	-
MCC (g)	30gm	10gm	30gm	10gm
CCS (g)	10gm	5gm	10gm	5gm
Alcohol (g/ml)	Q.S	Q.S	Q.S	-
Sodium Benzoate (g)	1gm	0.7gm	1gm	0.7gm
Talc (g)	2gm	0.5gm	2gm	0.5gm
Mgs (g)	2gm	0.gm	2gm	0.5gm

Table 3: Formulation table – For Suspension

Ingredients	F1	F2	F3
Pumpkin seed powder (gm/ml)	20gm	20gm	15gm
HPMC (gm/ml)	3hm	3gm	-
Sodium CMC (g/ml)	-	-	3gm
Propyl paraben (gm/ml)	0.1gm	0.1gm	0.1gm
Olive oil (gm/ml)	30ml	30ml	20ml
Coconut oil (gm/ml)	40ml	-	-
Avocado oil (gm/ml)	-	15ml	10ml
Tween 80 (gm/ml)	2ml	5ml	2.5ml
Stevia (gm/ml)	3gm	3gm	3gm
Chocolate syrup (gm/ml)	-	20ml	-
Chocolate powder (gm/ml)	-	-	7gm

EVALUATION

Table 4: Evaluation Studies and Tests

Evaluation Studies	Tests
Physicochemical Tests	i. Organoleptic analysis (Shape& Size) ii. Ingredient-excipient compatibility study by FTIR
Stability Studies	Overall stability
Particle size determination	DLS
Zeta potential	DLS

Ingredient-excipient compatibility study by FTIR

To determine if there was any interaction between the nutraceutical and the excipients used in the formulation, FTIR analysis was carried out using a Shimazu device. The FTIR spectrums of various excipients and pure nutraceutical individually as well as pure nutraceutical and excipients combined were studied[14].

Microbial Growth Study

It is done to study the growth of microorganisms under controlled laboratory conditions and observe their growth pattern over time.

Test setup:

1. Agar medium (contains peptone, beef extract, agar, sodium chloride and water with a pH of 7.2)
2. Distilled water
3. Petri dishes
4. Conical flask
5. Autoclave
6. Incubator
7. Inoculating loop

Test procedure:

1. At first 14gm of nutrient agar was in 500ml distilled water which was taken in a conical flask and dissolved properly.
2. The mouth of the conical flask was then sealed with cotton gauze and then the flask was placed inside the autoclave at 121degree Celsius for 15 minutes, till the

pressure inside it reached 15psi.

3. Then pour the sterile nutrient agar into the sterile petri dishes and allow it to solidify.
4. Then the test sample was transferred onto the solidified agar media with a sterile inoculating loop
5. The petri dish was then covered and incubated at a temperature of about 37 ± 0.2 °C overnight.
6. Then the microbial growth was checked at interval of 6hr, 12hr, 18hr and 24hr with the help of a spectrophotometer. If growth was observed, then growth curve was plotted.

Particle size determination, zeta potential determination

Particle size, zeta potential of the optimized pumpkin seed capsules and suspension were determined by dynamic light scattering (DLS) method using Malvern Zetasizer (Version 7.11) and Anton Paar Litesizer 500. The dispersion of suspension was suitably diluted with purified water before measurement.

Overall stability

It is to check whether the formulations are stable or not by various factors like temperature, humidity, light to consider the best stability formulation should be kept in stability chamber for a certain period of time.

The evaluation parameters are mentioned in table 4.

RESULT AND DISCUSSION

Organoleptic Analysis

The appearance of the prepared formulations of Pumpkin seed (Cucurbita pepo) capsules and suspension were evaluated by visual inspection. It is evaluated to determine their acceptability and patient compliance and characteristics. All the formulation for capsules(F1-F4) and Suspensions(F1-F3) were visually examined and noted its colour, odour, Appearance, texture. These features as a whole are indicative of the aesthetic and user-friendly nature of the formulations. The organoleptic analysis evaluation mentioned in table 5.

Ingredient-excipient compatibility study by FTIR

To determine if there was any interaction between the nutraceutical and the excipients used in the formulation, FTIR analysis was carried out using a Shimazu device. The FTIR spectrums of various excipients and pure nutraceutical individually as well as pure nutraceutical and excipients combined were studied.

Table 5: Organoleptic analysis table

Parameters	Capsules (F1-F4)	Suspension (F1-F3)
Appearance	Uniform, hard shell	Homogeneous, free flowing liquid
colour	white (capsule shell), light greenish (contents)	Light greenish to dark greenish
Odor	Mild nutty Odor	Strong nutty Odor
Taste	N/A (swallowed whole)	Bitter, oily and nutty
Texture	-	Slightly Viscous, Smooth consistency

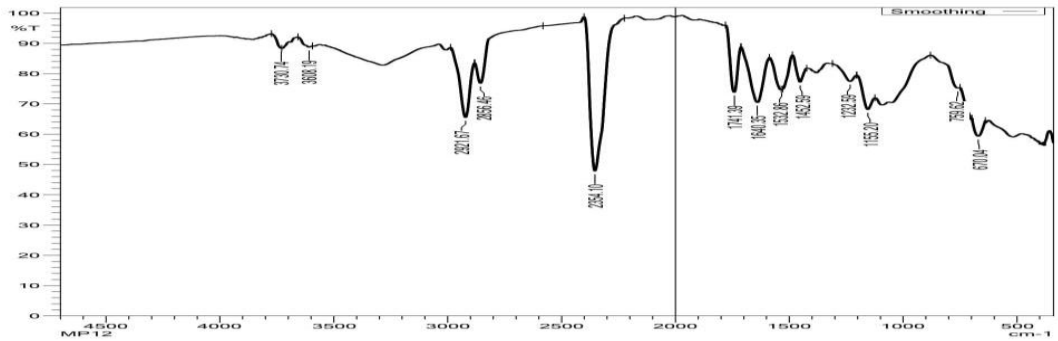

Figure 1: FTIR of pumpkin seed

Table 6: Observation table of the given peak of pumpkin seed

SL no	Reference peak wave numbers (cm^{-1})	Observed peak wavenumber (cm^{-1})	Functional group
1	600-900	670.04, 759.62	C-H Rocking weak
2	800-1200	1155.20	C-C Stretch medium weak
3	900-1300	1155.20, 1232.59	C-O Stretching Medium Strong
4	1300-1500	1452.59	C-H Bend in plane medium strong
5	1500-1700	1532.86,1640.35	N-H Bending medium
6	1600-1900	1741.39	C=O Stretch strong
7	2100-2400	2354.10	C≡C Stretch medium weak
8	2700-3300	2856.46, 2921.67	C-H stretch strong
9	3000-3700	3608.19	N-H Stretch medium

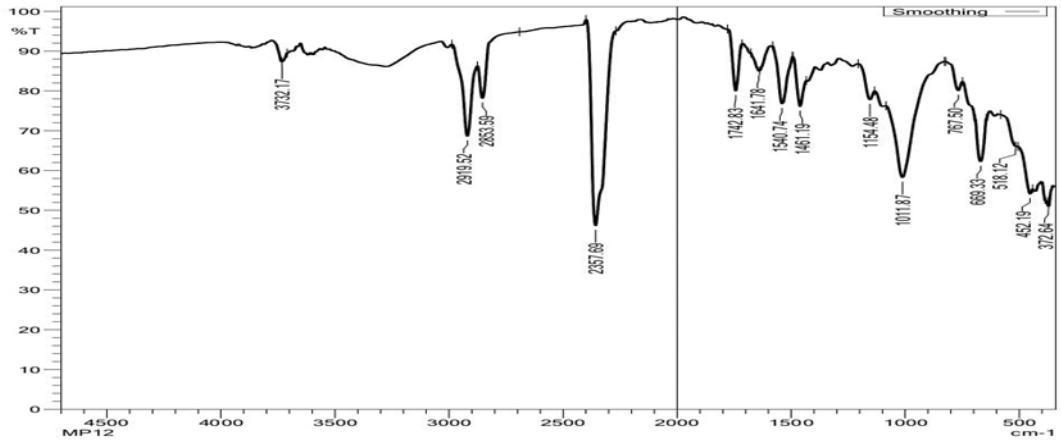

Figure 2: FTIR of Pumpkin seed with excipients

Table 7: Observation table of the given peak of pumpkin seed with excipients

Observed peak wavenumber (cm^{-1})	Reference peak wavenumbers (cm^{-1})	Functional group
669.33,767.50	600-900	C-H
1011.87, 1154.48	800-1200	C-C
1461.19	1300-1500	C-H
1641.78	1600-1700	C-C
1641.78, 1742.83	1600-1900	C=O
2853.59, 2919.52	2700-3300	C-H

Fig-1,2 represents the FTIR graph of pumpkin seed and pumpkin seed with excipients. The ingredient excipient compatibility study valley compares with the pumpkin seed IR spectra; it shows no chemical reactions between ingredient excipients, so it states that there was no interaction between ingredient and excipients. The observation of following peaks of both the graphs mentioned in table 6 and table 7.

Particle size determination, zeta potential and conductivity determination

Particle size, zeta potential and conductivity of the optimized pumpkin seed capsules and suspension were determined by dynamic light scattering (DLS) method using Malvern Zetasizer (Version 7.11) and Anton Paar Litesizer 500. The dispersion of suspension was suitably diluted with purified water before measurement.

Zeta potential measurements reflect the surface charge of the suspension and granules and are important in forecasting the stability of the formulation. Capsule batch(F1) shows a zeta potential -3.16mV, implying adequate physical stability as a result of adequate repulsive forces between particles. Fig -3 Represents the zeta potential of Pumpkin seed capsules.

The zeta potential of the prepared pumpkin seed suspension was obtained based on a DLS method. The zeta potential measured was –17.6 mV, which represents a moderately stable colloidal system. Based on regular colloidal stability criteria, values ranging from –10 mV to –30 mV indicate that the suspension has enough electrostatic repulsion to avoid aggregation within a reasonable shelf life. Such a negative surface charge is largely due to the existence of anionic phytoconstituents like fatty acids and phenolic compounds found in the water extract of Cucurbita pepo seeds. The zeta potential value indicates that although the system is susceptible to weak flocculation, it is physically stable under ordinary storage conditions without the imminent risk of particle agglomeration or settling, particularly if formulated with proper suspending agents. Fig-4 Represents the zeta potential of pumpkin seed suspension.

Conductivity analysis gives information on the ionic character and dispersion stability of the suspension in general. The electrical conductivity of the prepared pumpkin seed suspension was determined to assess the presence and mobility of the ionic species in the water medium. The suspension had a conductivity of 0.036 mS/cm (36 µS/cm) at room temperature.

This lower conductivity points towards a moderate content of dissolved electrolytes and agrees with the phytochemical content of pumpkins seeds that contain high amounts of non-electrolyte compounds in the form of fatty acids, sterols, and polysaccharides. The low ion content can be attributed to the minimal dissociation of organic substances in the aqueous medium and the non-availability of supplementary salts or strong electrolytes in the product.

From a formulation viewpoint, this low conductivity is desirable for chemical stability since high ionic strength can catalyse bioactive component degradation. It also reduces the possibility of electrochemical interaction with package materials and decreases the likelihood of oxidative reaction.

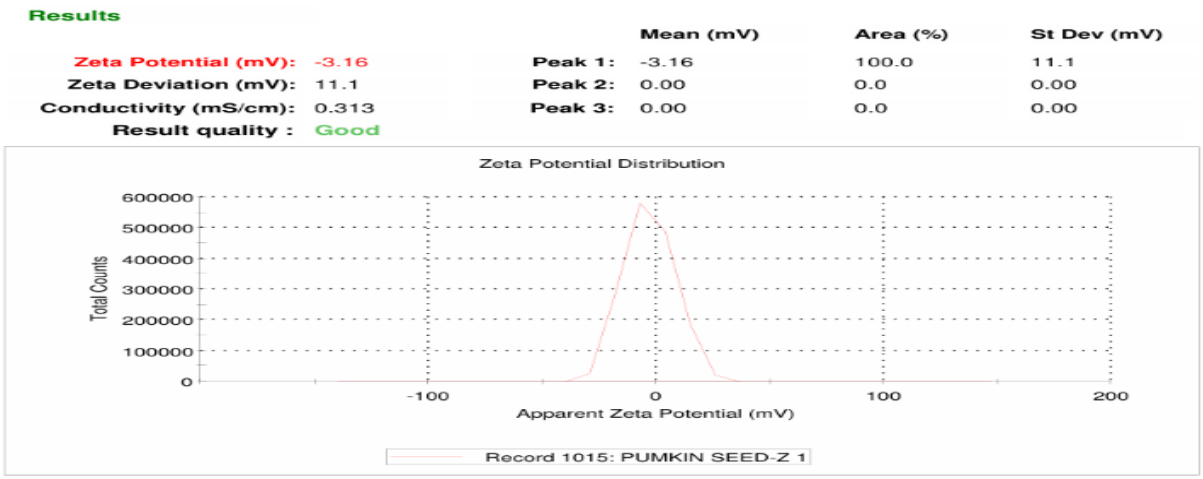

Figure 3: Zeta potential of pumpkin seed Capsules

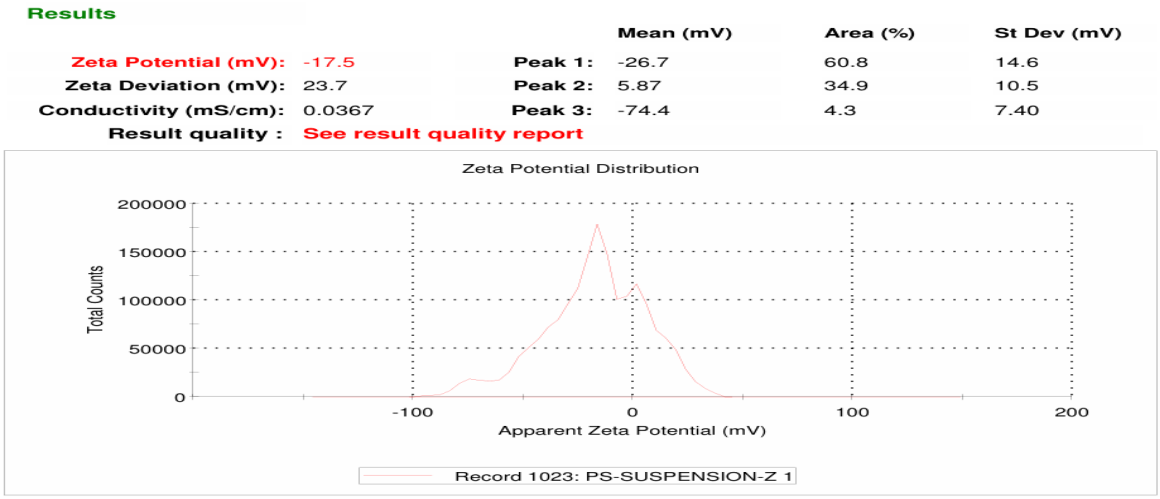

Figure 4: Zeta potential of Pumpkin seed suspension

Overall Stability

Table 8: Observation of stability studies as ICH guidelines

Parameters	Storage Condition								
	40 ± 2⁰C/ 75 % RH ±5%			36 ± 2⁰C/ 70%RH ±5%			40⁰C/ 75%RH ±5%		
	15 Days	30 Days	45 Days	15 Days	30 Days	45 Days	15 Days	30 Days	45 Days
Bulk Density	No change	No change	No change	No change	No change	No change	No change	No change	No change
Tapped Density	No change	No change	No change	No change	No change	No change	No change	No change	No change
Angle of repose	No change	No change	No change	No change	No change	No change	No change	No change	No change
Sieve Analysis	No change	No change	No change	No change	No change	No change	No change	No change	No change
Colour	No change	No change	No change	No change	No change	No change	No change	No change	No change
Odour	No change	No change	No change	No change	No change	No change	No change	No change	No change
Taste	No change	No change	No change	No change	No change	No change	No change	No change	No change
Texture	No change	No change	No change	No change	No change	No change	No change	No change	No change

The observation of stability studies is mentioned in table 8. The stability testing showed that the formulations both capsules and Suspensions were stable over exposed environmental condition, which means the formulations have a good shelf life.

CONCLUSION

The current work effectively proved the development and testing of pumpkin seed-based capsules (F1-F4) and suspension(F1-F3) as nutraceutical formulations. Both preparations were designed to release major bioactive phytochemicals—namely, phytosterols (β-sitosterol), tocopherols, and phenolic compounds—rich in antioxidant, anti-inflammatory, and prostate health-supporting activity. The formulations possessed good physicochemical characteristics, such as disintegration time, uniformity, and stability. These results justify the therapeutic potential of pumpkin seed preparations, especially in the case of benign prostatic hyperplasia (BPH) and oxidative stress disorders. In general, pumpkin seed-derived nutraceuticals are a promising natural strategy for preventive and supportive health care, with future clinical assessment and product development potential[15-18].

Zeta potential analysis indicated good colloidal stability for the majority of formulations, particularly F1, F3 and F2 had lesser stability. F1 had maximum zeta potential, which could be caused by ionic interactions and might impact long-term stability. Particle size of capsules batch F1 and Suspension batch F1 are respectively 121.9nm and 98.68nm which indicates a stable formulation.

No microbial growth has been seen in all the formulation of Pumpkin seed (Cucurbita pepo) Capsules batches (F1-F4) and Suspensions batches(F1-F3).

In total, capsules batch F1 and Suspension batch F1 have shown better stability and have chosen the best candidate for Nutraceutical Supplement and the formulations have great potential for further clinical development as a nutraceutical Supplement for BPH and other lower urinary tract symptoms.

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REFERENCES

1. Lee YK, WI Chung, H Ezura. Efficient Plant Regeneration via Organogenesis in Winter Squash (Cucurbita maxima Duch). Plant Sciences, 2003;164(3): 413-418.
2. Jia W, W Gao, L Tang. Antidiabetic herbal drugs officially approved in China. Phytotherapy Research. 2003;17(10):1127-1134.
3. Adolfo AC, H Michael. Mexican plants with hypoglycemic effect used in the treatment of diabetes. Journal of Ethnopharmacology. 2005;99:325-348.
4. Yadav M, S Jain, R Tomar, GBKS Prasad, H Yadav. Medicinal and biological potential of pumpkin. Nutrition Research Review. 2010;23(2):184 190.
5. Seema Patel. Pumpkin (Cucurbita sp) seeds as nutraceutic: a review on status quo and Scopes. Mediterranean Journal of Nutrition Metabolism. 2013;6(3):183-189.
6. Naghii MR, M Mofid. Impact of daily consumption of iron fortified ready-to-eat cereal and pumpkin seed kernels (Cucurbita pepo) on serum iron in adult women. Biofactors. 2007;30(1):19-26.
7. Ardabili, AG, R Farhoosh, M HH Khodaparast. Chemical Composition and Physicochemical Properties of Pumpkin Seeds (Cucurbita pepo Subsp pepo Var Styriaka) Grown in Iran. Journal of Agriculture Sciences and Technology. 2011;13:1053-1063.
8. N Manda Devi, RV Prasad And Nukasami Sagarika, A Review on health benefits and nutritional composition of pumpkin seeds, International Journal of Chemical Studies, 2018;6(3): 1154-1157
9. Giuseppe Procida, Bruno Stancher, Francesca Cateni and Marina Zacchigna, Chemical composition and functional characterisation of commercial pumpkin seed oil, Wileyonlinelibrary, DOI 10.1002/jsfa.5843.
10. Maria Batool , Muhammad Modassar Ali Nawaz Ranjha , Ume Roobab , Muhammad Faisal Manzoor ,Umar Farooq , Hafiz Rehan Nadeem, Muhammad Nadeem , Rabia Kanwal , Hamada AbdElgawad ,Soad K. Al Jaouni , Samy Selim, and Salam A. Ibrahim, Nutritional value, Phytochemical Potential, and Therapeutic Benefits of Pumpkin (*Cucurbuta sp.*), MDPI, Plants 202 ;11:1394. https://doi.org/10.3390/plants11111394
11. Nikan Zerafatjoul, Mohammadali Amirzargar, Mahdi Biglarkhani, Farzaneh Shobeirian and Ghazal Zoghi, Pumpkin seed oil (Cucurbita pepo) versus tamsulosin for benign prostatic hyperplasia symptom relief: a single-blind randomized clinical trial, BMC Urology, https://doi.org/10.1186/s12894-021-00910-8
12. Agnieszka Nawirska-Olszan´ ska, Agnieszka Kita, Anita Biesiada, Anna Sokół-Łe¸ towska,Alicja Z. Kucharska, Characteristics of antioxidant activity and composition of pumpkin seed oils in 12 Cultivars, Food Chemistry, Elsevier http://dx.doi.org/10.1016/j.foodchem.2013.02.009
13. Ecanow B, Webster JM, Blake MI. Conductivity studies of suspension systems in different states of aggregation. J Pharm Sci. 1982 Apr;71(4):456-7. doi: 10.1002/jps.2600710422. PMID: 7086659.
14. Lin SY. Current and potential applications of simultaneous DSC-FTIR microspectroscopy for pharmaceutical analysis. J Food Drug Anal. 2021 Jun 15;29(2):182-202. doi: 10.38212/2224-6614.3345. PMID: 35696204; PMCID: PMC9261823.
15. Csikós E, Horváth A, Ács K, Papp N, Balázs VL, Dolenc MS, Kenda M, Kočevar Glavač N, Nagy M, Protti M, Mercolini L, Horváth G, Farkas Á, On Behalf of the Oemonom. Treatment of Benign Prostatic Hyperplasia by Natural Drugs. Molecules. 2021 Nov 25;26(23):7141. doi: 10.3390/molecules26237141. PMID: 34885733; PMCID: PMC8659259.
16. Vahlensieck W, Theurer C, Pfitzer E, Patz B, Banik N, Engelmann U. Effects of pumpkin seed in men with lower

urinary tract symptoms due to benign prostatic hyperplasia in the one-year, randomized, placebo-controlled GRANU study. Urol Int. 2015;94(3):286-95. doi: 10.1159/000362903. Epub 2014 Sep 5. PMID: 25196580.

17. Damiano R, Cai T, Fornara P, Franzese CA, Leonardi R, Mirone V. The role of Cucurbita pepo in the management of patients affected by lower urinary tract symptoms due to benign prostatic hyperplasia: A narrative review. Arch Ital Urol Androl. 2016 Jul 4;88(2):136-43. doi: 10.4081/aiua.2016.2.136. PMID: 27377091.
18. Shaban A, Sahu RP. Pumpkin Seed Oil: An Alternative Medicine. Int J Pharmacogn Phytochem Res. 2017;9(2):11-8. doi: 10.25258/phyto.v9i2.8066. Epub 2017 Feb 25. PMID: 34924730; PMCID: PMC8681145.