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Research Article

Comparative study on physiochemical and flow properties of Chickpea and Maize starch

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Abstract

Excipients are generally materials other than the active ingredients basically required in the manufacturing of all types of pharmaceutical formulations. Recent years witnessed the increase in the number of researchers carrying out on the excipients derived from naturl sources such as, polysaccharides and conclued that natural excipients are comparable and could be alternative to the synthetic addditives. However, choosing the optimum excipients requires striking a balance between time and cost savings, as well as expected product performance. Starch is considered to be one of the most commonly used excipients for pharmaceutical preparations. Non-conventional starch sources have been studied profoundly in recent years for searching new additive properties. Chickpea (Cicer arietinum L.) is the largest produced food legume in globally. The objective of the present study was to compare the physiochemical and flow characteristics of starches from chick pea and maize. Starch was isolated and evaluated its physical, chemical and functional properties. Solubility of both chickpea and maize starches was increased with increasing temperatures. The Pre-compression tests such as angle of repose, bulk density, tapped density, Hausner's ratio, and % compressibility of starch were carried out which showed that Chick pea starch powder is non-free flowing and has a low interparticulate friction.

Keywords: Excipients, Chickpea starch, Maize starch, Flow properties, Physiochemical properties.

INTRODUCTION:

Excipients are essential components of any dosage form as well drug delivery system and commonly used as fillers, binder, disintegrants, glidants, lubricant and release modifier[1]. There is always a quest for natural excipients to replace synthetic materials because of their superior benefits such as safety and biocompatibility[2]. Starch is one of the most established excipients used for solid dosage formulations due to its unique properties such as, biocompatibility, biodegradability, gelation and modification ability to multifaceted use[3]. At present the search for new starch sources is prime object of many scientific researchers, mainly aimed at new physicochemical and functional properties.

Legumes have been considered as the most significant food source for people of low incomes. Dry legumes are important ingredient of diet in many parts of the world. Among dry legumes, green peas, dry beans, chickpeas, and lentils are the most common. Starch is the major carbohydrate of legume seeds and is considered of commercial importance due to its high industrial demand. Chickpea (Cicer arietinum) is a type of edible legume under the family of Fabaceae and subfamily of Faboideae .Chickpea (Cicer arietinum) is the world's most important grain legume containing 16-21% protein, 3% ash, 3-7% lipids, 5-13% crude fibre and 59-67% carbohydrates, and of the total grain carbohydrates, about 40-50% is starch[4-5] .The present research was carried out to isolate starch from Chickpea (Cicer arietinum) and to study and compare the physicochemical properties in order to ascertain flow and compressibility properties.

MATERIALS AND METHODS:

Materials:

Chickpea was obtained from local market of Nagpur, Maharashtra and were identified at Department of Pharmacognosy, Smt. Kishoritai Bhoyar College of pharmacy, Kamptee. All other chemicals used were of analytical and better grade.

Starch isolation:

Chick pea Starch was isolated from chickpea by the modified method of Vasanthan (2001). Chickpeas were weighed, rinsed, and used for starch extraction. For 16 hours, the chickpea was soaked in a 1:4 ratio of water and milk was obtained and collected by wet grinding starch. Following that, the starch milk was filtered through a succession of polypropylene screens and further centrifugation, and purification were performed.. The starch obtained was dried in an oven with circulating air at 40 °C for 12 h and the dried starch ground in

a mortar and sieved (60 mesh) and kept in a firmly closed container in a dry environment until required for analysis [6].

Determination of physicochemical properties:

Organoleptic Properties:

Organoleptic characters of maize starch (MS) and chickpea starch (CPS) and like color and odour was evaluated.

Melting Point:

The melting point of chickpea and maize powder was determined by capillary method.

Moisture Content:

The moisture content was determined in a Moisture Analyzer (AND - Mod MX-50), using 1 g of sample at a temperature of 105 °C.Moisture content was estimated by the method of Adebayo et al. (2010)[7].

Solubility index:

About 500 mg of chick pea Starch sample was added to 10 ml distilled water and heated in water bath at 50-700 C for 30 min. After centrifugation at 1500 rpm for 30 min, about 5 ml of the supernatant was dried to constant weight. The solubility was expressed as the percentage (%) by weight of dissolved starch from heated solution[8].

FTIR of starch Powder:

Starch sample was prepared using the pellet method. In this procedure, a few milligrams of the starch sample were mixed with about 0.5 g of potassium bromide. The mixture was pressurized to 20 psi to produce pellets with a size of 13 mm. The pellet was placed in the spectroscope sample holder between the interferometer and the detector. The resulting pellets were placed in a suitable holder on an FTIR spectrophotometer (Shimadzu Asian Pacific Pvt. Ltd, Singapore).

Particle size determination of starch powder:

Particle size of the CPS starch powder is determined by digital Motic microscope (Motic B-1 Series).

Precompression Property of starch powder:

Bulk density and Tapped density[9]:

Loose bulk density (LBD), tapped bulk density (TBD),, angle of repose, Compressibility index of Starch powder were determined.

Bulk density (Db) was calculated as,

Bulk Density(Db) = M/Vb

Where,

M = weight of the powder

Vb = bulk volume of the powder

Tapped density was calculated as,

Weight in grams =Tapped density /Volume in mL

The procedure was done in triplicate

Flow Properties:

The flow properties of the powders were determined by the indirect methods: Carr's compressibility index and angle of repose

Compressibility (Carr's index):

This property is also known as compressibility. It is indirectly related to the flow rate, cohesiveness and particle size. It is a simple, fast and popular method of predicting powder flow characteristics. It is determined by using following formula

I = Dt- Db/ Dt × 100

Where,

Dt = tapped density of the powder

Db = bulk density of the powder

Angle of repose (θ):

The angle of repose of the powder mixture was determined by the funnel. An accurately weighed powder mixture was placed in a funnel. The height of the funnel was adjusted so that the tip of the funnel just touched the apex of the powder mixture pile (2 cm). The powder mixture was free to flow through the funnel to its surface. The diameter of the powder cone was measured and the angle of repose was calculated using the following formula.

$\theta = \tan^{-1}(h/r)$

Where,

θ = angle of repose

H= Height of the pile

r = average radius of the powder cone.

RESULT AND DISCUSSION:

Determination of physiochemical properties:

Maize starch powder is white, while Chick pea starch powder is yellowish white. Both starch powders were all found to be odourless. Melting point of Maize starch and Chick pea starch powder found to be of 230-232^{0}C, 217-220^{0}C respectively.

Moisture content:

Moisture content of the chickpea starch and Maize starch was found to be 10.13±0.88 % and 8.98±1.23% respectively.

Solubility Index:

Starch solubility of chickpea starch (2.13-6%) and maize starch (2-6.5%) increased slightly from 50°C to 70°C.

FTIR Study:

FTIR of MS:

Figure no.1 shows MS FTIR spectra with observed frequencies of 2929.97 for C-H stretching, 1641.48 for C=C stretching, 1417.73 for C-O stretching, 1365.65 for C-O stretching, 1155.40 for O-H stretching, and 860.28 for C-H stretching.

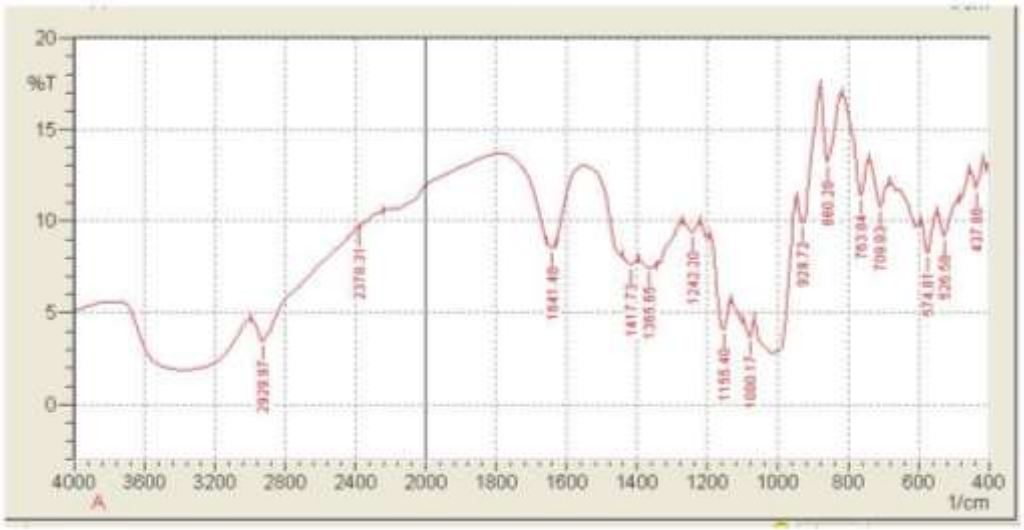

Figure 1: FTIR of Maize starch (MS)

FTIR of CPS:

Figure no.2 shows FTIR spectra of CPS with observed frequencies of 2928.04 for C-H stretching, 1647.26 for C=C stretching, 1419.66 for C-O stretching, 1367.58 for C-O stretching, 1157.33 for O-H stretching, and 858.35 for C-H stretching.

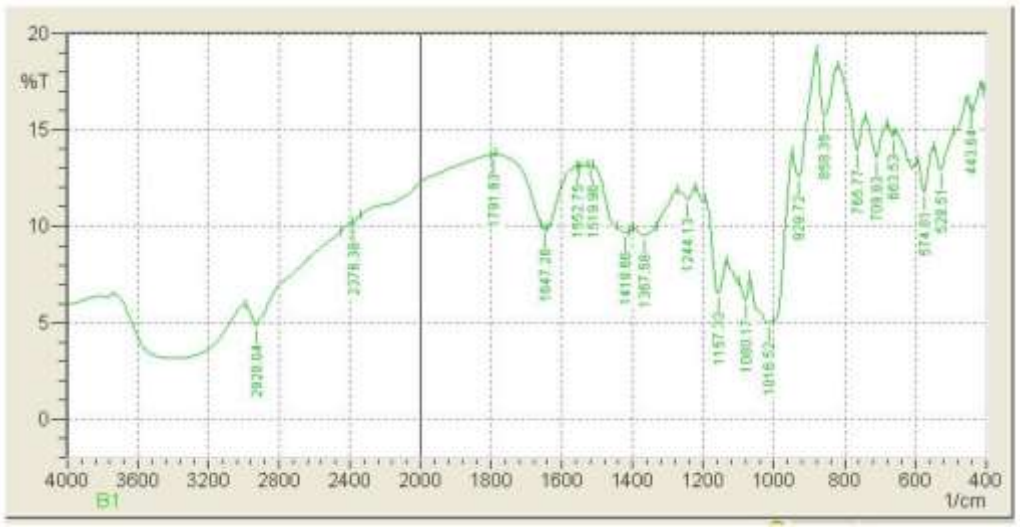

Figure 2: FTIR of Chickpea starch (CPS)

The study showed comparative frequency and peaks as that of maize starch which confirms the identification of Chick pea starch.

Particle size determination of starch powder (MS, CPS):

Particle size of different starch powder is determined by digital microscope (Motic B-1 Series). There is no significant change in particle size of starch powder, according to the particle size determination.

Table 1: Particle size of MS and CPS starch

Type of starches	Radius	Area	Perimeter
MS	1.7um	10.8sum	11.2um
	1.9um	11.9squm	11.2um
CPS	1.8um	9.9squm	11.1um
	2.1um	14.2squm	13.4um

Pre-compression test of starch powder (MS, CPS):

The Pre-compression test like angle of repose, bulk density, tapped density, hausner ratio, and % compressibility of different starch shown in table no 3.

Table 2: Pre-compression test of MS and CPS starch powder

Test	MS	CPS
Angle of repose(θ)	39.12±0.14	37.46±0.16
Bulk density (g/ml)	0.43±0.04	0.47±0.04
Tapped density(g/ml)	0.66±0.02	0.71±0.04
Hausner ratio	1.53±0.03	1.51±0.03
% Compressibility	33.84±1.47	33.80±1.22

Angle of repose of MS and CPS was found to be 39.12±0.14 and 37.46±0.16 respectively that indicate a comparative flow of powder. Bulk density was found to be 0.43±0.04 and 0.47±0.04 respectively. Tapped density was found to be 0.66±0.02 and 0.71±0.04 respectively. Hausner ratio was found to be 1.53±0.03 and 1.51±0.03 respectively. % compressibility was found to be 33.84±1.47 and 33.80±1.22 respectively. The results showed no significant difference in all the parameters. This showed that Chick pea starch powder is non-free flowing and has a low interparticulate friction.

CONCLUSION:

Starches from various non conventional sources have been studied by many researchers and, searching for new pharmaceutical properties is still in its infancy. The present study showed that starch could be isolated with simple techniques from chick Pea. The bulk density, true density , flow properties of CPS could be comparable with the maize starch. Moisture content of Chickpea starch was also high.

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation**.**

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REFERENCES:

1. Lango KB, Gowthaman S, Seramaan KI, Chidambaram K, Bayan MF, Rahamathulla M, Balakumar C. Mucilage of Coccinia grandis as an Efficient Natural Polymer-Based Pharmaceutical Excipient. Polymers (Basel). 2022 Jan 5; 14(1):215. doi: https://doi.org/10.3390/polym14010215

2. Fulbandhe VM, Jobanputra CR, Wadher KJ, Umekar MJ, Bhoyar GS. Evaluation of release retarding property of gum damar and gum copal in combination with hydroxypropyl methylcellulose. Indian J Pharm Sci. 2012 May; 74(3):189-94. doi: https://doi.org/10.4103/0250-474X.106059. PMID: 23440630; PMCID: PMC3574527.

3. Omojola MO, Akinkunmi YO, Olufunsho KO, Egharevba HO, Martins EO. Isolation and physico-chemical characterization of cola starch. African Journal of food, agriculture, nutrition and development. 2010; 10(7):2884 - 900. https://doi.org/10.4314/ajfand.v10i7.59042

4. Singh, K.B., Bejiga, G. and Malhotra, R.S. Genotype-environment interactions for protein content in chickpea. J. Sci. Food Agric, 1993; 63:87-90. https://doi.org/10.1002/jsfa.2740630114

5. Builders PF, Anwunobi PA, Mbah CC, Adikwu MU. New direct compression excipient from tigernut starch: physicochemical and functional properties. AAPS PharmSciTech. 2013 Jun; 14(2):818-27. doi: https://doi.org/10.1208/s12249-013-9968-7 Epub 2013 May 7. PMID: 23649994; PMCID: PMC3666000.

6. Vasanthan, T. Overview of Laboratory Isolation of Starch from Plant Materials. Current Protocols in Food Analytical Chemistry, 2001; 00(1):E2.1.1-E2.1.6. doi: https://doi.org/10.1002/0471142913.fae0201s00

7. Adebayo, A.O., Lateef, S.O. and Elizabeth, A.B. Physicochemical, Rheological and Consumer acceptability of cassava starch salad cream. Journal of American Science. 2010; 6(1):65-72.

8. Afolayan MO, Omojola MO, Orijajogun JO, Thomas SA. Further physicochemical characterization of Anchomanes difformis starch. Agriculture and Biology Journal of North America 2012; 3(1):31-8. https://doi.org/10.5251/abjna.2012.3.1.31.38

9. Wadher KJ, Kakde RB, Umekar MJ. Formulation and evaluation of a sustained-release tablets of metformin hydrochloride using hydrophilic synthetic and hydrophobic natural polymers. Indian J Pharm Sci. 2011 Mar; 73(2):208-15. doi: https://doi.org/10.4103/0250-474X.91579 PMID: 22303065; PMCID: PMC3267306.