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SCOPE AND EVALUATION OF SAPODILLA PECTIN IN PHARMACEUTICAL SOLID AND LIQUID ORALS WITH ESPECIAL REFERENCE TO ITS EFFECT ON VARIOUS PHYSICO-MECHANICAL PROPERTIES UPON BOTH SOLID AND LIQUID DOSAGE FORM

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ABSTRACT: The aim of this study was to understand and study the role and effect of different concentration of sapodilla pectin as a binding agent in tablet formulations and also its on the effect on physical evaluation of suspension. For this purpose two model drugs paracetamol and ibuprofen were selected and granules were made by wet granulation using different concentration of pectin. The tablets were first tested for its micromeritics properties of the granules. After the formulation of the desired tablets, they were compressed and were tested for quality. While for suspension kaolin and sapodilla pectin were used in combination to form antidiarrheal preparation and was evaluated physicaly. It was found that the concentration of added pectin has an influence on both the micrometric properties of granules as well as on the dissolution profile of formulated tablets. Both the tablets showed increasing hardness and lowering of dissolution rate with the addition of increased amount of pectin. However the best formulation for paracetamol was F4 and F5 with 40 and 50 mg of pectin respectively while for ibuprofen R1 it was with 50mg of pectin concentration. The antidiarrheal preparation also exhibited similar results in terms of its evaluation as suspension. The study clearly showed that pectin from sapodilla peel can be used effectively in the formulation of paracetamol and ibuprofen tablets as well as in antidiarrheal suspension.

INTRODUCTION: The fabrication and design of a dosage form requires careful biological and chemical examination of all the constituents used in the formulation of the product. To produce an effective and safe formulation, it is pertinent to ascertain the compatibility of all the ingredients used.

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The excipients are the components present in the pharmaceutical formulations other than active pharmacological drug. Among the various excipients, binders are used to increase the adhesive properties of granules which is necessary for their compressibility [1]. Binders are mixed in the formulation of tablets to increase their mechanical strength and to increase the cohesive power in tablets [2]. Among the various types of binders, naturally originated binder are use on a large scale both in food and pharmaceutical industry due to their less toxicity, bio-degradability, easy availability and cost effectiveness[3]. Currently many types of plant originated gums are in use as binders

in pharmaceutical preparation such as gelatin, acacia, alginic acid, guar gum *etc*., research to find new binders will be advantageous for the industry[4].

The role of pectin is quite diversified in pharmaceuticals. These include both therapeutic as well as excipient. In the view of its properties to increase the viscosity and volume of stool, it has its applications both in diarrhoea and constipation. Though, FDA has discontinued pectin in 1992, it is still use in other countries. It is also extensively used in Alternative System of Medicine (such as Ayurvedic and Unani system of medicine) alone or in combination with certain herbs or minerals as a compound or poly herbal formulations. Moreover pectin is an FDA approved polymer and consider among GRAS (Generally Recognized as Safe) as listed in Code of Federal Regulations (CFR 21) [5]. Pectin derived from orange peel has been tested for binding property and gave better results than starch when used in the same kind of formulation. It was stated that orange peel pectin has great prospect of replacing the commercially available polymers as binders in tablet dosage form [6].

Solid oral dosage form have a prominent position among the various types of oral dosage forms present in the market, the reason being patient's compliance which mainly rely on its ease of use and cost effectiveness [7]. Among the various naturally originated polymers used in the pharmaceutical formulations, polysaccharides are gaining popularity. The reason for this popularity can be linked with its physical properties like biodegradability and least toxicity. One another important factor is that these natural polymers can be chemically altered so as to minimize their undesired effects, and thus, forming new materials with different physicochemical properties [8].

The scope of this present study was to asses a new source of pectin extracted from sapodilla peel pectin and its effect as binder in tablet formulation using two model drugs paracetamol and ibuprofen. The granules were prepared using wet granulation techniques and were assessed for their physic-mechanical properties to determine the effective use of sapodilla pectin in the pharmaceutical formulations. Antidiarrheal is also important pharmaceuticals preparations which can be formulated with the use of pectin. Hence an antidiarrheal formulation has been prepared and evaluated for its physical properties.

MATERIALS AND METHODS: The pectin from sapodilla fruit was extracted using the following method described by Patel *et al*., [9] The fruits were taken fresh from the local market and was immediately used for the extraction of pectin.

Formulation of Tablet Using Extracted Pectin from Sapodilla Peel: Nine formulations for paracetamol and four formulations for Ibuprufen were designed by the method described by Menon *et al*., (2011) [10] with slight modifications for direct compression. The composition of 700mg tablet made by wet granulation method is mentioned in **Table 1** for paracetamol tablet and **Table 2** for ibuprofen tablets. The amount of active ingredient (Paracetamol / Ibuprofen), binder, disintegrate and diluent were mixed after weighing each amount according to the size of batch.

TABLE 1: COMPOSITION OF PARACETAMOL TABLET WITH DIFFERENT CONCENTRATIONS OF PECTIN USED

S. no	Ingredients	S1 (mg/tab)	F1 (mg/tab)	F2 (mg/tab)	F3 (mg/tab)	F4 (mg/tab)	F5 (mg/tab)	F6 (mg/tab)	F7 (mg/tab)	F8 (mg/tab)
1	Paracetamol	500	500	500	500	500	500	500	500	500
2	Microcrystalline cellulose	30	30	30	30	30	30	30	30	30
3	Pectin		10	20	30	40	50	60	80	100
4	Starch	10								
5	Lactose	153	153	143	133	123	113	103	83	63
6	Talc	5	5	5	5	5	5	5	5	5
7	Magnesium Sterate	2	2	2	2	2	2	2	2	2

Where F1= test formulation one, F2= test formulation two, F3=test formulation three, F4 = test formulation four, F5=test formulation 5, F6=test formulation six, F7 test formulation seven, F8= test formulation eight, F9=test formulation nine while S1 is standard

All the ingredients were mixed and passed through sieve # 40 separately. The ingredients were then mixed with distilled water as granulating agent and a dough is formed. The dough was then passed

through sieve #16 to get coarse granules which were then dried on 45 °C for almost 2 hours. The dried granules were then passed through sieve # 20 to obtain equal sized granules. The obtained granules were then mixed with the weighed amount of glident and lubricant. The mixture was mixed evenly through tumbler movement. The finally obtained granules were then compressed through single punch machine to make tablets of required weight and hardness. The comparative effect of binding property of pectin was determined, control tablets were made with the addition of starch instead of pectin as the binding agent.

TABLE 2: COMPOSITION OF IBUPRUFEN TABLET WITH DIFFERENT CONCENTRATIONS OF PECTIN USED

S. no	Ingredients	S2 (mg/tab)	R1 (mg/tab)	R2 (mg/tab)	R3 (mg/tab)	R4 (mg/tab)
1	Ibuprofen	400	400	400	400	400
2	Microcrystalline cellulose	30	30	30	30	30
3	Pectin		50	75	100	125
4	Starch	10				
5	Lactose	153	113	88	63	38
6	Talc	5	5	5	5	5
7	Magnesium state	2	2	2	2	2

Where R1= TrRal formulation one, R2 = test formulation two, R3 =test formulation three, R4 = test formulation four

Evaluation of Granules: The granules were evaluated for the flowability according to the method given in USP 36/ NF 31, 2013 guidelines[11], the test performed were angle of repose, bulk density, tapped density, compressibility index, Hausner's ratio and loss on drying.

Tablet Compression: The granules obtained were compressed using a single punch machine in which a convex shaped punch of diameter 12.38mm was fitted to get oval shaped tablets each weighing about 700 mg (±5%). The hardness was set between 6-7 kg compression ranges. The compression was done at room temperature and a minimum of fifty tablets were compressed for each batch.

Tablets Testing: The finally compressed tablets were evaluated for quality parameters following the guidelines of USP 36/ NF 31 2013[11] and some non-pharmacopeial methods which are described below:

Weight Variation: The variation in weight of the test formulations and reference tablets were studied by taking weight of each 20 tablets individually on a Type 1 balance. Mean weight and standard deviation were calculated.

Tablet Thickness and Diameter: The Diameter and thickness of 20 tablets were determined by a Vernier caliper in mm.

Tablet Hardness: It is calculated by randomly selected 20 tablets of the test formulations using a Hardness Tester.

***In-vitro* Dissolution Studies:** The dissolution studies of the test and standard tablets performed following method given in USP 32/NF 27, 2009 guidelines [12] by using a USP apparatus II. It was carried out in 900 ml of phosphate buffer pH 5.8 at 37±5 °C at 50 rpm. An aliquot of 10 ml of solvent was taken out from vessels at 5, 10, 15, 20, 25, 30, 45, 60, 90 and 120 minutes and volume was made up again by fresh medium. Spectrometer was used to calculate drug concentration at 278nm with dissolution medium taken as blank. The dissolution profile was also established in distilled water, 0.1 N HCl of pH 1.2 and phosphate buffers at pH 4.5, 6.8 using the same sampling times as described above to evaluate the release of drug in the new formulations. Each experiment was repeated in triplicate.

Formulation of Antidiarrheal Preparation (Suspension) from Extracted Sapodilla Pectin: In a 3000ml container 620ml distill water was taken. Erythrosine, bronopol, propyl paraben and sodium saccharin were added one by one. In the next step pectin is added, followed by veegum, sodium carboxymethyl cellulose. The mixture was stirred and soaked overnight. More distill water was added with glycerin at this stage. The mixture was then continuously stirred and kaolin was added gradually. The mixture was further mixed thoroughly for an hour and the final volume was adjusted using DI water. Lastly vanilla flavour was added. The formulation ingredients with their respective amounts are given in **Table 3**.

TABLE 3: COMPOSITION OF ANTIDIARRHEAL PREPARATION USING EXTRACTED SAPODILLA PECTIN

S. no	Ingredient	1litre	1000 ml
1	Deionized water	0.62 lit	620ml
2	Erythrosine	0.0000248kg	24.8mg
3	Bronopol	0.0001kg	100mg
4	Propylparaben (Sodium)	0.00055kg	550mg
5	Sodium saccharin	0.00075kg	750mg
6	Pectin	0.00434kg	4340mg
7	Veegum	0.004kg	4000 mg
8	Sodium carboxy methyl cellulose	0.0016kg	1600mg
9	Water	0.02 litre	20ml
10	Sodium	0.002kg	2000mg
11	Glycerine	0.1lit	100ml
12	Kaolin	0.2kg	200000mg
13	Flavours	0.004lit	4 ml
	Make up the volume to	1 L	1000 ml

Evaluation of Suspension:

Color, Odor and Taste: Organoleptic evaluation of suspension was performed for its color, odor and taste properties.

pH: The pH of the suspension was measured by using pH meter.

Viscosity: The viscosity of suspension was evaluated using Oswald viscometer. The suspension is filled in the required volume very carefully with the help of a pipette into the viscometer. The viscometer was then kept into a water bath to achieve the desired temperature. When the temperature reached to a constant temperature the volume in the viscometer was adjusted again carefully using pipette. The pressure is then released and the time is noted for the suspension to reach from one point to the other.

Sedimentation Volume: 25ml of suspension was taken in a 50ml stoppered graduated measuring cylinder. The suspension was then moved upside down two three times and then allowed to settle for three minutes and the volume of sediment was noted which was considered as the original volume (H_0). The cylinder was then kept stationary for 7 days and the volume of sediment was noted at 7hrs and 24hrs for consecutive 7 days. This was considered as the final volume (Hu). The sedimentation volume was calculated as Sedimentation Volume (F) = Hu/ Ho. The height of the solid phase after settling relies on the particle size and the concentration of solid. For a desirable suspension F should be 0.9 for 1 hr.

Redispersibility: For the measurement of redispersity a fixed volume of suspension was kept in a stoppered cylinder at room temperature for 7 days. The suspension in the cylinder was moved upside down at regular intervals to remove any sediments present at the bottom of the cylinder.

RESULTS AND DISCUSSION: Sapodilla peel pectin, used as a binder in formulation of paracetamol and ibuprofen tablet, was evaluated for pre-compression, micrometrics and dissolution properties. The weight of both the types (paracetamol and ibuprofen) remained under the limit of ± 5%. The diameter and thickness of all the tablets also didn't exceeded from the required level (**Table 5** and **8**).

In paracetamol tablets 10 and 20 mg of pectin were found not suitable to achieve desired hardness granules when compressed into tablets were soft and thus further concentration of pectin was increased. When the concentration increased from 30mg/tab desired hardness was achieved (**Table 5**) however interestingly as the concentration of pectin was increased, dissolution was noted to be decreased. The best hardness and dissolution was achieved with the formulation F4 and F5 when the concentration of 40mg/tab and 50mg/tab was used respectively. Dissolution was recorded as 80.43% and 86.35% respectively (**Table 6**). Further increased in pectin from 60 to 120mg not only increased the hardness of tablet, but also noted to decrease the dissolution significantly. While the ibuprofen tablets showed a similar type of result. It was also noted that the higher concentrations of

pectin had detrimental effect on dissolution properties of tablets.

Sapodilla crude pectin extracted was used in the preparation of two common pharmaceutical solid oral formulations, paracetamol and ibuprofen tablets .The extracted sapodilla pectin was used as a binding agent in both formulations and were evaluated for different physico-mechanical and micromeritics properties. As sapodilla pectin is a new source of pectin which has not been reported in earlier studies in tablet formulation therefore, it is important to determine the micromeritics of granules .The nature and concentration of a binder can effect on the compression, mechanical strength, consolidation, flow and mechanical strength of a tablet [13]. **Table 4** and **7** represents the micrometrics properties of granules formulated with different concentrations of binder which is pectin in this case, in paracetamol and ibuprofen tablets respectively.

The compressibility index of paracetamol came out to be in range from 4.618 to 24.603 %. Among the different formulations F4 and F5 has excellent compressibility index (4.618% and 5.690 % respectively) and Hausner ratio (F4=1.048 and F5=1.060), F6 was good for both compressibility index and Hausner's ratio and F1, F2, F7 and F9 were fair formulations while F3 and F8 were passable .The angle of repose came out to be under 21.546. While for ibuprofen Carr's index was excellent for all four formulations (**Table 8**) and excellent to fair Hausner ratio for the four formulations. R1 showed excellent Hausner ratio (1.09) and compressibility index (3.77) while angle of repose was also better for all four formulations which came in between 11.13 to 15.25.

The weight variation of tablet is a credible sign of the uniformity of constituents present in the formulation which is a basic requirement of good manufacturing practice as well as important for keeping a constant size of the tablets [14]. Uniformity in weight of tablet is also required as the table contains the active compound or drug which should be present in a specific ratio, weight is an important indicator that the drug in the tablet is in required limit or not. The weight of both the types (paracetamol and ibuprofen) remained under the limit of ± 5%. The diameter and thickness of all the tablets also didn't exceed from the required level (**Table 5** and **8**). Hardness is also an important parameter which is useful to control chipping, abrasion or breakdown of tablets during storage and transportation of tablets [15]. Therefore, the method to check hardness is the breaking of tablet by applying reasonable pressure on it. Hardness is also an important parameter to ascertain the quality of a drug as it also effects disintegration and dissolution of a tablet [14].

In paracetamol tablets, 10 and 20mg of pectin were found unsuitable to achieve desired hardness granules when compressed into tablets were soft and thus further concentration of pectin was increased. When the concentration increased from 30mg/tab desired hardness was achieved (**Table 5**) however interestingly as the concentration of pectin was increased upto a certain limit, dissolution was noted to decrease. The best hardness and dissolution was achieved with the formulation F4 and F5 when the concentration of 40mg /tab and 50mg/tab were used respectively. Dissolution was recorded as 80.43% and 86.35% respectively (**Table 8**). Further increased in pectin from 60 to 120mg not only increased the hardness of tablet but also decreased the dissolution significantly. The ibuprofen tablets also showed similar type of results (**Table 9**).

It is also noted that the higher concentrations of pectin had detrimental effect on dissolution properties of tablets. Among ibubrufen tablets 50mg of pectin gave the best dissolution results as compared to the rest of the formulations containing 75mg, 100mg and 125mg of pectin as a binder. It was also observed that the hardness of the tablet was successfully increased by increasing the binder but it significantly affected the tablets dissolution property of ibuprofen tablet. The bulk and tap density results selected formulation shows that the granules have a good flow and compressibility property and the same observation supported the Carr's index and Hausner ration results. Tablet hardness are usually required between 6 - 14 KP and is primarily based on the friability less than 0.1% and DT not more than 5 min results which a drug formulation targets to achieve.

The particle distribution result shows good combination of cores and fine granules for weight variation control during compression. The thickness of the tablets are also found consistent, indicating reasonable justification to use blister packaging very common for these (active pharmaceutical ingredients (APIs) in Pakistan. Uniformity in blend shows good distribution of API while dissolution result also supports selection of compression parameters.

Antidiarrheal preparation formulated from extracted pectin also showed similar results as compared to the marketed product (**Table 10**). An antidiarrheal preparation was also formulated with the extracted sapodilla pectin. The basic evaluation tests (**Table 10**) of suspension indicated no major difference between the physical attributes of suspension made from sapodilla pectin and marketed products. Pectin is an effective antidiarrheal agent and together with kaolin it acts as adsorbent resulting in more solid form stool and it also has affinity to attach the digestive mucus and toxins hence aids in reducing water loss [16, 17]. The use of kaolin-pectin antidiarrheal preparation is still common in Middle east and Gulf [18] South Africa [19], Indonesia [16] and Australia [19] (Bis pectin, 2016) Although FDA has discontinued the use of kaolin / pectin suspension early 2000, the use of kaolin pectin as adsorbent has proved effective in the pharmacological treatment of for non-infectious HIV-associated diarrhea [20].

The primary function of pectin based antidiarrheal is to provide water soluble fibers capable of stimulating epithelial growth in the colon helping in the reduction of diarrheal frequency. Apart from this, pectin possess strong water holding capacity, water and fat binding properties which ultimately helps to change the consistency of stool from watery to soft and also helps in eliminating excess mucus formed in GI tract. In the present study the water holding capacity of extracted pectin was noted as 6.99 g/g while the formulated suspension indicated 32.69 g/g which was quite comparable with the reference sample (Kepect) showing value of 33.96 g/g.

TABLE 4: FLOW PROPERTIES OF GRANULES MADE FOR PARACETAMOL TABLETS

Test Formulation	Mass (g)	Bulk Volume (ml)	Tapped Volume (ml)	Bulk Density (g/ml)	Tapped Density (g/ml)	Angle of Repose (θ^{-1})	Compressibility Index (%)	Hausner Ratio -
Standard	2.004±0.001	4.5068±0.115	4.123±0.125	0.446±0.051	0.487±0.057	17.955±1.158	8.41±0.507	1.091±0.006
F1	2.010±0.005	3.867±0.115	3.067±0.115	0.520±0.014	0.656±0.023	18.747±0.543	20.702±0.608	1.261±0.010
F2	2.003±0.001	3.867±0.115	3.067±0.115	0.518±0.015	0.654±0.024	16.494±1.680	20.702±0.608	1.261±0.010
F3	2.008±0.001	4.067±0.115	3.067±0.115	0.494±0.014	0.655±0.024	16.558±1.792	24.603±0.687	1.326±0.012
F4	2.008±0.001	4.333±0.115	4.133±0.115	0.464±0.012	0.486±0.014	17.545±1.540	4.618±0.125	1.048±0.001
F5	2.004±0.001	3.533±0.306	3.333±0.306	0.570±0.051	0.605±0.057	17.955±1.158	5.690±0.507	1.060±0.006
F6	2.005±0.001	4.133±0.115	3.667±0.462	0.485±0.014	0.552±0.065	17.453±0.171	11.032±13.884	1.141±0.163
F7	2.016±0.021	4.000±0.200	3.333±0.306	0.505±0.021	0.608±0.056	17.987±0.618	16.700±5.888	1.204±0.082
F8	2.020±0.010	4.067±0.115	3.067±0.115	0.497±0.014	0.659±0.025	21.546±0.441	24.603±0.687	1.326±0.012

F1-F9 = test formulations 1 till 9, each value is a Mean ± SD of three determination.

TABLE 5: PHARMACEUTICAL CHARACTERISTICS OF COMPRESSED FORMULATION OF PARACETAMOL TABLET

Test Formulation Pharmacopoeial Limits (USP 32/NF 27)	Wt. Variation (Mean ± S.D) (mg) ±5%	Thickness (Mean ± S.D) (mm) ± 5%	Diameter (Mean ± S.D) (mm)	Hardness (Mean ± S.D) (kg) At least 5 kg	Loss on drying % Not more than 1.5%
Standard	702.67± 2.52	5.60±0.20	9.47±0.05	5.22±0.01	4.0%
F1	705.00±5.00	5.22±0.03	9.42±0.03	2.54±0.06	4.0%
F2	672.33±2.52	5.24±0.05	9.39±0.01	1.37±0.07	3.0%
F3	701.33±3.21	5.32±0.05	9.45±0.04	4.16±0.08	4.3%
F4	695±5.00	5.35±0.06	9.44±0.05	5.06±0.21	4.2%
F5	705±4.51	5.21±0.03	9.41±0.03	5.15±0.07	4.6%
F6	701.67±3.97	5.19±0.04	9.42±0.03	5.21±0.07	4.3%
F7	708.3±2.89	5.29±0.04	9.31±0.03	6.07±0.12	4.2%
F8	694.67±4.51	5.27±0.13	9.27±0.06	6.67±0.58	4.5%
F9	704.00±3.61	5.27±0.10	9.42±0.04	7.40±0.33	4.5%

F1-F9 = test formulations 1 till 9; each value is a Mean ± SD of three determination

TABLE 6: DISSOLUTION STUDIES OF PARACETAMOL TABLET

Formulation Number																	
F1 243nm (Abs)	F2 % Release	F3 243nm (Abs)	F4 % release	F5 243nm (Abs)	F6 % release	F7 243nm (Abs)	F8 % release	F9 243nm (Abs)	F1 243nm (Abs)	F2 % release	F3 243nm (Abs)	F4 % release	F5 243nm (Abs)	F6 % release	F7 243nm (Abs)	F8 % release	F9 243nm (Abs)
0.304	43.43	0.339	50.64	0.401	58.77	0.269	71.52	0.564	0.304	43.43	0.339	50.64	0.401	58.77	0.269	71.52	0.564
0.291	41.67	0.338	50.49	0.412	60.39	0.283	70.28	0.557	0.291	41.67	0.338	50.49	0.412	60.39	0.283	70.28	0.557
0.362	51.83	0.564	84.25	0.382	55.99	0.331	83.13	0.418	0.362	51.83	0.564	84.25	0.382	55.99	0.331	83.13	0.418
0.372	53.26	0.557	83.20	0.389	57.02	0.333	87.28	0.620	0.372	53.26	0.557	83.20	0.389	57.02	0.333	87.28	0.620
0.313	44.82	0.418	62.44	0.577	84.58	0.285	85.20	0.406	0.313	44.82	0.418	62.44	0.577	84.58	0.285	85.20	0.406
0.323	46.24	0.406	60.65	0.590	86.48	0.312	85.20	0.632	0.323	46.24	0.406	60.65	0.590	86.48	0.312	85.20	0.632
Standard for formulation																	
0.692	99.10	0.664	99.10	0.676	99.10	0.478	99.10	0.664	0.692	99.10	0.664	99.10	0.676	99.10	0.478	99.10	0.664

F1-F9 are test formulation while Abs = absorbance and % release = percent release

TABLE 7: FLOW PROPERTIES OF GRANULES FOR IBUPROFEN TABLET

Test Formulation	Mass (g)	Bulk Volume (ml)	Tapped Volume (ml)	Bulk Density (g/ml)	Tapped Density (g/ml)	Angle of Repose (θ^{-1})	Compressibility Index (%)	Hausner Ratio
Std	2.02±0.013	4.25±0.015	3.75±0.092	0.475±0.002	0.538±0.020	11.71±0.210	11.71±0.116	1.132±0.061
R1	2.02±0.013	4.20±0.015	3.76±0.093	0.49±0.003	0.55±0.019	15.23±0.208	4.82±0.115	1.13±0.061
R2	2.01±0.016	4.35±0.042	3.61±0.010	0.46±0.005	0.56±0.004	13.83±0.153	9.74±0.344	1.24±0.059
R3	2.01±0.007	4.35±0.042	3.93±0.064	0.42±0.021	0.52±0.010	13.73±0.306	7.40±0.352	1.17±0.028

R1= Test formulation one, R2= Test formulation two, R3= Test formulation three, R4= Test formulation four. Each value is a Mean ± SD of three determinations

TABLE 8: PHARMACEUTICAL CHARACTERISTICS OF COMPRESSED FORMULATION OF IBUPROFEN TABLET

Test Formulation Pharmacopoeial Limits (USP 32/NF 27)	Wt. Variation (Mean ± S.D) (mg) ±5%	Thickness (Mean ± S.D) (mm) ±5%	Length x width (Mean ± S.D) (mm) _	Hardness (Mean ± S.D) (kg) At least 5 kg	Loss on Drying %
Std	601.33±1.15	6.33± 0.06	20 x 9.5	6.13± 0.14	4.5%
R1	600.33±1.53	6.23± 0.06	20 x 9.5	6.23± 0.14	4.9%
R2	598±1.73	6.37±0.06	20 x 9.5	8.40±0.40	4.8%
R3	603.±2.31	6.22±0.03	20 x 9.5	9.23±0.14	4.9%
R4	602.33±2.52	6.27±0.06	20 x 9.5	10.43±0.18	4.7%

TABLE 9: DISSOLUTION STUDIES OF IBUPRUFEN TABLETS

Formulation number							
R1	R1	R1	R1	R1	R1	R1	R1
243nm (Abs)	243nm (Abs)	243nm (Abs)	243nm (Abs)	243nm (Abs)	243nm (Abs)	243nm (Abs)	243nm (Abs)
0.405	0.405	0.405	0.405	0.405	0.405	0.405	0.405
0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415
0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420
0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425
0.429	0.429	0.429	0.429	0.429	0.429	0.429	0.429
0.430	0.430	0.430	0.430	0.430	0.430	0.430	0.430
Standard for formulation							
0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.503

R1-R4 are test formulation while Abs = absorbance and %release = percent release

TABLE 10: BASIC EVALUATION TEST OF ANTIDIARRHEAL FORMULATION PREPARED FROM SAPODILLA PECTIN

Parameters	Suspension made from sapodilla pectin	Comparative suspension*
Color	Pinkish white	white
Odor	Vanilla	Vanila
Taste	Sweet	sweet
pH	6.1	5.56
Viscosity	14.14	13.13
Sedimentation rate	0.3	0.1
Redispersity	+++	+++
WHC	32.69	33.56

+ denotes the number of times the cylinder was moved. * Keptin antidiarrheal preparation

CONCLUSION: Although there has been a number of a research in past few years regarding the use of pectin as binder yet no comprehensive study was done after extracting pectin from sapodilla fruit peel. The formulation of solid oral pharmaceutical (tablets) is a very vast field and needs good and cost effective binders in developmental work. The extracted Sapodilla pectin was observed a good binder to be utilized in some tablet formulation. Although dissolution studies were conducted, however it is suggested to perform kinetic studies as well in future for more authentic data and effect of Sapodilla pectin as a binder. Antidiarrheal preparations formulated in the present studies were compared with the marketed product showed similar results, especially when tested for its water holding capacity. In addition, the water binding and fat binding capacities of extracted pectin indicated a promising results. This confidently pointed towards the potential use of sapodilla pectin in antidiarrheal preparation. However, in vivo procedures can add more data if performed in future studies.

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