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EXTRACTION, CHARACTERIZATION AND FUNCTIONALIZATION OF TAMARIND KERNEL POWDER- A NOVEL PHARMACEUTICAL EXCEPIENT

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ABSTRACT

The objective of this study was to extract and further characterize the tamarind kernel powder (TKP) obtained from Tamarindus indica as an excipient and explores its pharmaceutical applications. The tamarind seeds were kept in hot air oven at 50^{o}c for half an hour. The outer seed coat was removed and the kernels were grounded to fine powder. The obtained powder was sieved through suitable sieves. The powder was analyzed by FTIR. The Pre-formulation studies were conducted for dried Tamarind kernel powder. The floating nature and Super disintegrant activity were studied by preparing dummy tablets. The Mucoadhesive strength was measured by Modified physical balance method by using goat mucosa. The work has concluded that Tamarind kernel powder is an emergent excepient and can be used as super disintegrant, polymer in sustained and controlled drug delivery and as a bioadhesive polymer.

KEYWORDS: Tamarind kernel pwder, Muco adhesive, Super disintegrant, Modified physical balance method, Floating lag time and Disintegration time etc.

1. INTRODUCTION

The attention towards polysaccharides of natural origin is constantly rising during the past decade. The natural polysaccharides are widely used in the field of food technology, cosmetics, pharmaceuticals and biomedical sciences. Exploitation of new sources of

polysaccharides of different origin is well documented in the literature. They exhibit good mechanical properties and are widely used as fibers, films, adhesives, rheology modifiers, hydrogels, emulsifiers and drug delivery agents. Sodiumalginate (SA), xanthan gum (XG), guar gum, scleroglucan, and locust bean gums are some of the natural polysaccharides which are fueling the interest of the researchers dealing with the development of drug delivery systems.

TKP is a plant polysaccharide derived from the Tamarindus indica Linn seed endosperm from Fabaceae family. TKP have 1735 k Dalton molecular weight.[1]

It is a water-soluble, non ionic, branched polysaccharide with hydrophilic, gel-forming, and mucoadhesive characteristics.[2]

It also biodegradable, biocompatible, non carcinogenic, and irritant-free. It is used in the pharmaceutical, cosmetic, and food industries as a promising biopolymer.[3]

In recent years, it has been extensively studied and used as a successful pharmaceutical excipient in a variety of drug delivery applications. Tamarind gum is used in the development of drug delivery systems for the oral, intestinal, ophthalmic, buccal, and nasal routes.[4]

Tamarind kernel polysaccharide (TKP) is a natural branching polymer isolated from the endosperm of Indian date (Tamarindus indica Linn.) of family Leguminosae. TKP is made up of a beta -D- glucan backbone chain, which is linked to side chain of beta-D- galactopyranose and alpha-D-xylopyranose. TKP is non-carcinogenic, biocompatible, and stable even at acidic pH levels. So it can be employed in a variety of pharmaceutical formulations as binder, thickening, emulsifier, suspending agent, and release modifier. Tamarind Kernal powder (TKP) is manufactured by removing the outer cover of the seed and grinding creamy white kernals. To obtain a yield of 55-60%, machines grind the decorticated seed to the needle size. The powder is conventionally stored in a dry place due to increased risk of deterioration in humid environments. Prevention of enzymatic deterioration is achieved by mixing 0.5% sodium bisulphite with the TKP pre-packing. Inadequate storage of TKP causes a rancid odour and colour change to brown, the colour change can be reversed by the process of defatting.

Various functionally derivatized TGP has recently gained popularity as potential pharmaceutical excipients in a variety of improved drug delivery systems, owing to their

improved stability (lower degradability). These functionally derivatized tamarind gums have improved mechanical behavior and are capable of regulating drug release over a longer period. The present study deals with a detailed evaluation of several types of tamarind gum functionalizations for application in the development of better drug delivery systems.[5]

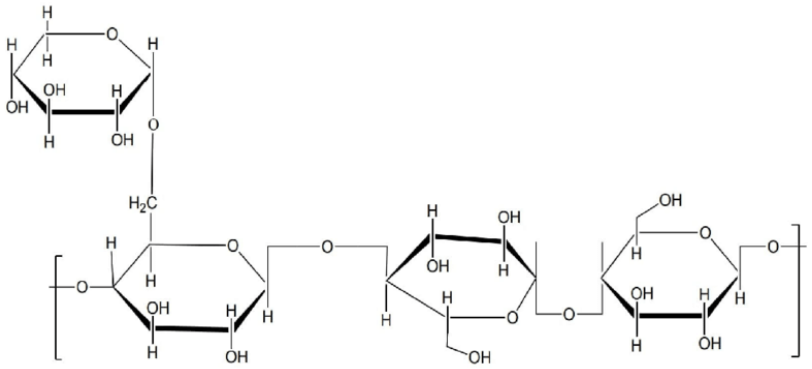

Fig. 1: Chemical Structure of tamarind seed polymer.[5]

2. MATERIALS AND METHODS

2.1 Materials

Tamarind kernel powder, Microcrystalline cellulose, Lactose, Sodium starch glycolate, Magnesium stearate, Talc and Sodium bicarbonate.

Tamarind seeds were obtained from the local market tagarapuvalasa, Visakhapatnam. Remaining all the chemicals were purchased from yarrow chemicals, Mumbai, India.

2.2 Preformulation studies

The pre-formulation studies were done for tamarind kernel powder by following standard procedures. The various physical properties of tamarind gum like pH, Surface tension, Viscosity, Swelling index were measured along with these total ash value and water soluble ash value were measured and results were given in table no1. FTIR studies were done by taking TKP in combination with different excipients and the graphs were given in the figure.

2.3 Physicochemical characterization of tamarind kernel powder[5]

Table 1: Physico chemical properties of TKP.

s. no	Identification test for	Procedure
1	Carbohydrates	1%of the solution of TKP was prepared in distilled water. 2 drops of alpha naphthol was added to the solution in the test tube. The test tube was incline carefully and 1 ml concentrated sulfuric acid was poured dropwised.
2	Proteins	1%TKP+Biuret reagent
3	Tannins	1%TKP+5%$FeCl_3$
4	Alkaloids	1%TKP+Dragendroffs reagent
5	Glycosides	Pure TKP was dissolved in a mixture of 1% ferric sulphate solution in (5%) glacial acetic acid Add one or two drops of concentrated sulfuric acid.

2.4 Organoleptic properties of tamarind gum

The gum was characterized for organoleptic properties such as taste as color, odour and texture.

2.5. Super disintegrant activity- TKP

Dummy tablets of two sets one contain TKP as super disintegrant and another contain Sodium starch glycolate by increase in concentration (formulations were given in table no2) were prepared and tested for disintegration time and results were given in table no2.

Table 2: Formulation of dummy tablets to test super disintegrant activity of TKP.

Formulation	F1	F2	F3	F4	F5
MCC	100mg	100mg	100mg	100mg	100mg
Lactose	43.5	41	38.5	43.5	41
TKP	2.5	5	7.5	-	-
Sodium starch glycolate	-	-	-	2.5	5
Mg sterate	2	2	2	2	2
Talc	2	2	2	2	2

The disintegration time was measured using standard disintegration apparatus using water as solvent.

2.6. Floating behavior of Tamarind Kernel powder

Four sets of dummy tablets were prepared and observed for floating lag time and floating time and results were given in table no3.

Table 3: Formulation of floating tablets with TKP.

Formulation	FTF1	FTF2	FTF3	FTF4
Lactose	50	50	50	50
MCC	50	50	50	50
NaHCO3	60	60	-	-
Talc	5	5	5	5
Magnesium stearate	5	5	5	5
TKP	100	150	100	150
Xanthangum	-	400	400	400

2.7 Measurement of Mucoadhesive nature of TKP

Preparation of transdermal patches: To measure the bioadhesive nature of TKP, Transdermal patches were prepared by solvent casting method.

Table 4: Formulation of transdermal patches with TKP to study muco adhesive nature.

Formulation	TPF1	TPF2
TKP	100mg	150mg
HPMCK4M	100mg	100mg
PEG6000	100mg	100mg
Ethanol	10ml	10ml
Water	q.s	q.s

Measurement of Bio adhesive strength by Modified Physical balance method

A modified balance method used for determining the ex vivo mucoadhesive strength. Fresh goat mucosa was obtained and used within 2h of slaughter. The mucosal membrane separated by removing underlying fat and loose tissues. The membrane was washed with distilled water and then with 0.1N HCL at 37□C. The mucosa was cut into the pieces and washed. A piece of mucosa was tied to the Teflon piece, which was kept in beaker filled with HCL pH 1.2, at 37□C ±1□C. The Teflon pieces was tightly fitted into a glass beaker so that it just touched the mucosa surface. The bioadhesive patch was stuck to the lower side of a pan. The weight of 5 g was kept in the right hand pan, which lowered the pan along with the patch over the mucosa. The balance was kept in this position for 5 min to provide contact time for bioadhesion. The weight was removed. Then slowly increasing the weights, the exact weight at which patch was removed is measured and it was substituted in the corresponding formulas to measure force of adhesion.

Bioadhesive strength=weight at which patch removed

Force of adhesion = [bioadhesive strength]*9.81]/1000

3. RESULTS AND DISCUSSION

3.1. Preformulation studies of Tamarind kernel powder

Table 5: Results of physicochcemical tests for TKP.

Sno	Name of the test	observation	Inference
1.	Test for carbohydrates	Violet color appeared at the junction of the two liquids.	Positive
2	Test for protiens	Violet colour	Positive
2.	Test for tannins	No greenish precipitate	Negative
3.	Test for alkaloids	No red color was obtained	negative
4.	Test for glycosides	red color was obtained	positive

Discussion: Results of preliminary studies indicates the presence of carbohydrates, proteins and glycosides in tamarind kernel powder.

Table 6: Results for pre-formulation studies of TKP.

Property	
Bulkdensity	0.59g/cc
Tapped density	1.28g/cc
Hausners ratio	1.45
Compressibility index	5.78
Angel of repose	27.9
Surface tension	78dynes/cm
Porosity	1.46
Swelling index	1.58
Ash content	2.10
Water soluble ash	2.5ml

3.2 table 7: Organo leptic properties of TKP.

s.no	Organoleptic property	
1	Colour	Light whitish - light creamy
2	Odour	Slight odour
3	Texture	Coarse smoothy
4	Taste	Bitter

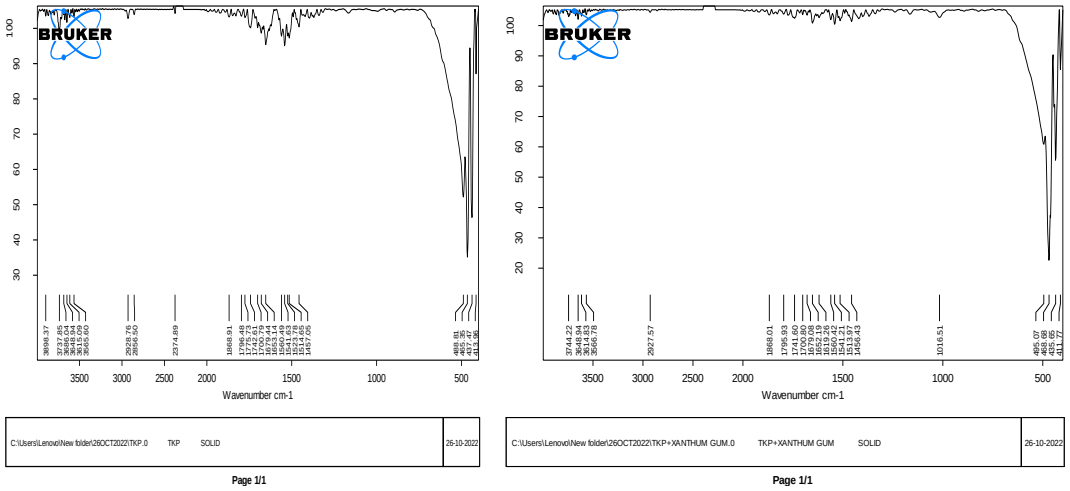

Fig. 2: FTIR graph for pure TKP. Fig3: FTIR graph for mixtureof TKP+Xanthangum.

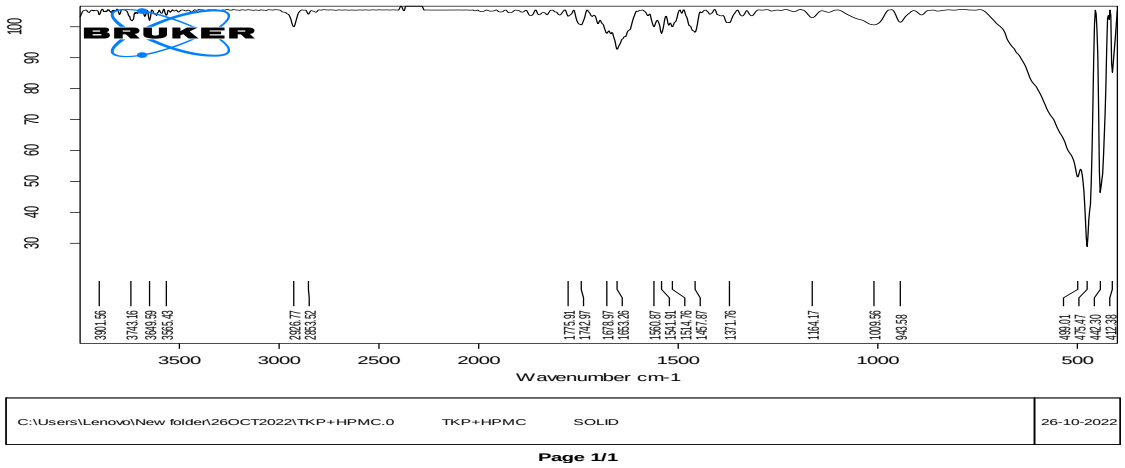

Fig. 4: FTIR graph for mixture of TKP and HPMC.

The FTIR graphs indicate there is no interaction between tamarind kernel powder and the given excepients (Hydroxy propyl methyl cellulose, Xanthan gum).

3.5 Results for super disintegrant activity on tkp

Table 8: Results for disintegration time.

Formulation	Disintegration time(Sec)
F1	30
F2	20
F3	10
F4	50
F5	40

The formulation F3 that contains 7%w/w tamarind kernel powder disintegrated within 10 sec. These results has shown that the tamarind kernel powder has super disintegrant property.

3.6 Results for floating activity of tamarind kernel powder

Table 9: Results for floating lag time.

Formulation	Floating lag time(sec)
FTF1	28
FTF2	19
FTF3	10
FTF4	9

The floating lag time values indicates the formulation FTF4 that is with 150mg Tamarind kernel powder and 400mg Xanthan gum has less floating lag time 9sec.

Ex-Vivo mucoadhesive strength of TKP

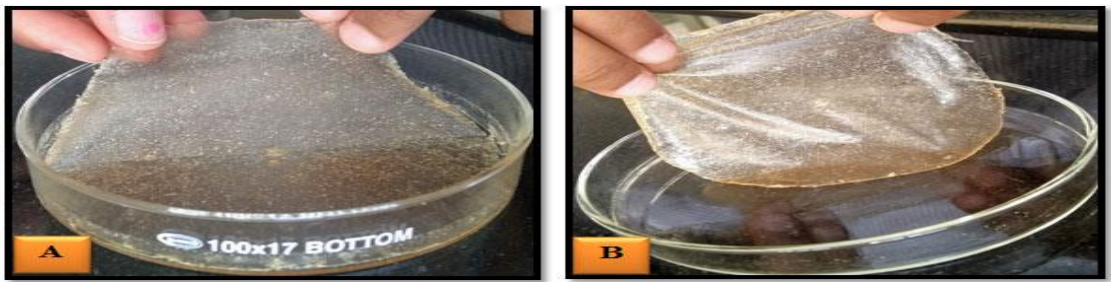

Fig. 4: Transdermal Patches prepared with tamarind kernel powder.

Fig. 5: Measurement of muco adhesive strength of tamarind kernel powder by modified physical balance method.

Table 10: Results for muco adhesive strength of TKP.

Formulation	F1	F2
Force of adhesion(N)	0.49	0.19
Bond strength($N\text{-}m^{-2}$)	0.102	0.039

CONCLUSION

Based on preformulation studies it was concluded that the tamarind kernel powder has carbohydrates and FTIR studies concluded that the TKP has no interaction with the given

excepients. The remaining studies has concluded that the tamarind kernel powder has super disintegrant activity and also floating nature based on adhesion force and bond strength values the TKP is having sufficient muco adhesive strength. The less bulk density might be the reason for floating nature and the presence of carbohydrates may lead to the muco adhesive nature. Hence the work has concluded that the tamarind kernel powder can be used as super disintegrant, floating as well as muco adhesive polymer in various formulations.

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