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A REVIEW ON: NOVEL APPROACH OF OKRA GUM

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ABSTRACT

The effectiveness of Okra gum in sustaining the release of propranolol hydrochloride in a tablet was studied. Okra gum was extracted from the pods of Hibiscus esculentus using acetone as a drying agent. Dried Okra gum was made into powder form and its physical and chemical characteristics such as solubility, pH, moisture content, viscosity, morphology study using SEM, infrared study using FTIR, crystallinity study using XRD, and thermal study using DSC and TGA were carried out. The powder was used in the preparation of tablet using granulation and compression methods. Propranolol hydrochloride was used as a model drug and the activity of Okra gum as a binder was compared by preparing tablets using a synthetic and a semisynthetic binder which are hydroxylmethylpropyl cellulose (HPMC) and sodium alginate, respectively. Evaluation of drug release kinetics that was attained from dissolution studies showed that Okra gum retarded the release up to 24 hours and exhibited the longest release as compared to HPMC and sodium alginate. The tensile and crushing strength of tablets was also evaluated by conducting hardness and friability tests. Okra gum was observed to produce tablets with the highest hardness value and lowest friability. Hence, Okra gum was testified as an effective adjuvant to produce favourable sustained release tablets with strong tensile and crushing strength. Binders constitute a major class of excipients that are used to hold the active pharmaceutical ingredients and other inactive ingredients together in a cohesive mass during granulation. The type and concentration of a binder influences the physicochemical characteristics of a compressed tablet. The aim of this study therefore is to examine and compare the binding and release properties of okra gum

with those of microcrystalline cellulose (Avicel) and acacia gum in erythromycin stearate tablet dosage form. Okra gum was extracted from the pods of locally cultivated Hibiscus esculentus in Okada Town. Unripe okra fruits were purchased from Edo State, Nigeria. The dried okra gum was then milled and sieved into fine powder form and evaluated for angle of repose, flow rate, solubility, pH and viscosity. The gum powder was used as a binder in the formulation of tablets using wet granulation and compression methods.

KEYWORDS: Binder, Control release, Drug delivery, Gum, Okro

- **Aim :** Novel Approach of Okra Gum (POLYMER / MUCILAGE)

- **The objective of the work :**

The major objective of the present investigation was to extract a natural polymer (okra gum) with its characterization as pharmaceutical binder and to formulate, develop, and evaluate the compression-coated tablet using okra as binder along with synthetic hydrophilic polymers like various grades of hydroxypropyl methylcellulose (HPMC).Methods: A novel extraction method was carried out using fresh unripe pods of okra (ladies finger) with the aid of organic solvents and its characterization was done. The core tablets were prepared by direct compression method which was compression coated with okra gum and HPMC.Results: After the extraction of the okra gum was carriedmucilage obtained was 10%.

INTRODUCTION :-

Natural polymers are obtained from the plant sources. They are high molecular weight and water-soluble polymers composed of monosaccharide units and united by glucosidal bonds. Some of the known polymers are pectin, guar gum, acacia, locust bean gum, tamarind gum, okra gum, etc. The uses of natural gums have increased a lot nowadays, due to their biodegradability in the body, their non toxic nature and sometimes they provide a rate retarding effect on the release of drugs in a particular dosage form. Okra (Abelmoschus esculentus) is the only vegetable crop of significance in the Malvaceae family and is very popular in the Indo-Pak subcontinent. It is an oligo purpose crop, but it is usually consumed for its green tender fruits as a vegetable in a variety of ways. These fruits are rich in vitamins, calcium, potassium, and other mineral matters. The mature okra seed is a good source of oil and protein has been known to have superior nutritional quality. Okra seed oil is rich in unsaturated fatty acids such as linoleic acid which is essential for human nutrition. They are also known as ladies finger. It is used as a binder and produces tablet formulations with good and optimum physicochemical properties. It also retards the release of drug, increasing the half-life of a successfully used in controlled/sustained release tablet formulations and is also a hydrophilic polymer. It is also used as retardant, disintegrant, suspending agent, and matrix

forming material. It is easily available and is quite economical. Being a natural polymer, it exhibits the property of biodegradation and mucoadhesion. Okra gum produces high viscosity mucilage at low concentrations. In continuation with the ongoing research on okra based formulations, the major objective of the present investigation was to prepare to compression, and evaluate the compression coated tablet using okra gum extracted from okra .

PLANT PROFILE, GEOGRAPHICAL DISTRIBUTION & MORPHOLOGY :-

- **Plant Profile :-**

The name ‘okra’ is most often used in the USA and is of East African origin. Okra is frequently known as lady’s fingers outside the USA. Okra is an annual or perennial, stout, erect, few-branching, herbaceous herb, growing to a height of 4 m. Okra is primarily a warm-

season plant. The plant does not tolerate chilling and frost. Once established, the species is one of the most heat- and drought-tolerant cultivated plants in the world. The fruits can be

Okra gum is a natural polymer obtained from the pods of okra plant (Abelmoschus esculentus). It has been used as a binder, hydrophilic polymer matrix, suspending, and bioadhesive agents. The potential of okra gum, obtained by traditional extraction, as a film coating agent was reported.

The aim of this study is to evaluate the adhesion ability of okra gum, which is gaining popularity as a tablet binder. For this purpose, gum was extracted from okra pods, and the binding strength of different concentrations (1%, 3%, and 5%) was determined quantitatively. Additionally, naproxen sodium tablets were prepared by using okra gum as a binder and were evaluated for their properties including hardness, friability, disintegration time, and dissolution rate. The binding strength values were compared with that of pre-gelatinized starch, a commonly used tablet binder. The results from universal testing machine indicate that the binding strengths of all dispersions of okra increase as the concentration increases from 1% to 5% and ranges from 2.5 to 4.5 N, which are almost twice a high as those of pre-gelatinized starch. The tablets prepared with okra gum have shown good mechanical strength with hardness values of 7–8.5 kg/cm2 and a friability <1%, comparable to tablets prepared with starch. The disintegration time was longer (7.50 min with okra gum and 5.05 min with starch paste), and the drug release from these tablets was slower than the formulations with starch. The higher binding ability of okra gum probably linked with its chemical composition as it mainly contains galactose, rhamnose, and galacturonic acid. This study concludes that okra gum is a better binder than pre-gelatinized starch, it might be explored in future for introduction as a cost-effective binder in the pharmaceutical.

- **Geographical Distribution** :-

The cultivation of okra extends throughout the tropics and warmer parts of temperate Asia. It is commercially grown in India, Turkey, Iran, West Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, West Bengal, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus, and the southern USA.

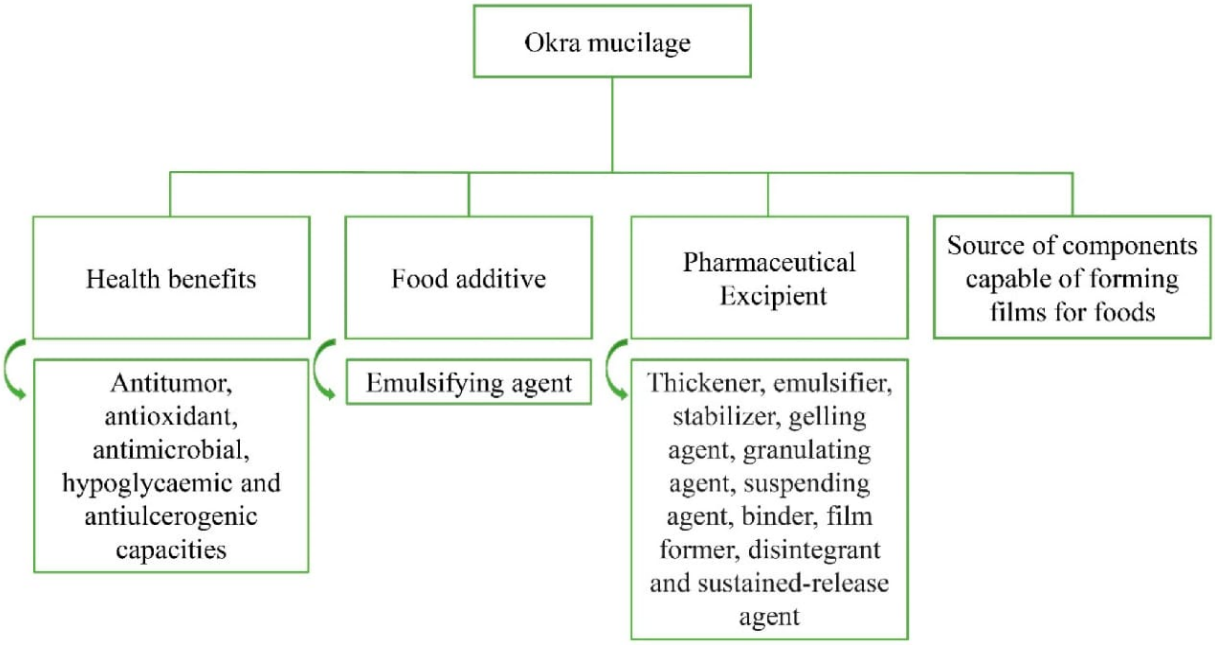
- **Morphology :-**

-Okra or Okro Abelmoschus esculentus, known in many English-speaking countries as ladies' fingers or ochro, is a flowering plant in the mallow family.

Okra leaves are heart-shaped and three- to five-lobed. The flowers are yellow with a crimson centre. The fruit, or pod, hairy at the base, is a tapering 10-angled capsule 10–25 cm (4–10

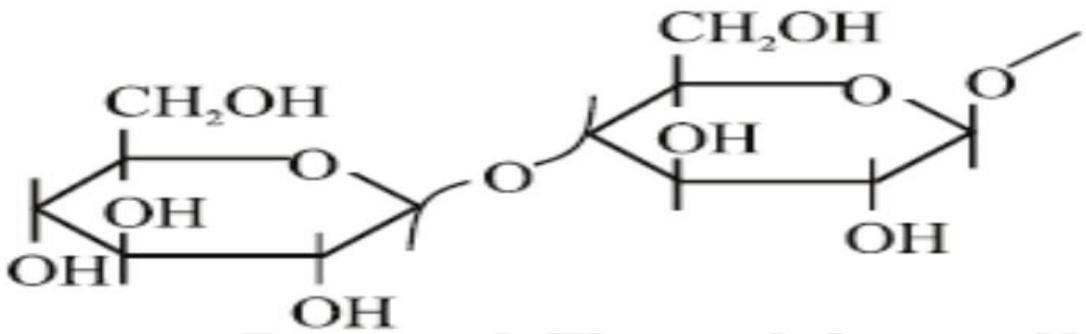
inches) in length (except in the dwarf varieties) that contains numerous oval dark-coloured seeds.

The fruits are heterogeneous and some are deformed, they have a long and fluted shape, with an average weight of 10.4 g and 95 seeds each weighing 0.05 g. The seeds are round with a conical micropyle, the testa is dark grey, and the embryo white.



(Molecular formula of okra mucilage) [monosaccaride]

ROLE OF OKRA IN DRUG DELIVERY :



- **As a binder**

Okra gum is a binding ingredient that improves the hardness, friability and dissolution rate of several tablet formulations. This natural binder on the other hand slows the dissolution of some slightly soluble drugs and could be a potential choice for binding formulations. The binding property of Abelmoschus esculentus fruit polymer is significantly superior, according

to the Compression coated tablets can be made using okra gum in various concentrations (3%, 4% & 5%) and three different grades of Hydroxypropyl methylcellulose (HPMC) in 30%, 60% and 90% concentrations. The swelling properties of the novel polymer okra can bedemonstrated in the characterization and despite being a hydrophilic polymer, it may be applied successfully in sustained release formulations. Drug release can be successfully delayed if the reaction is zero order. The study provides an insight on the use of okra gum as a rate retardant polymer that can be employed successfully as a binder in table compression.

The study found that compression coated Losartan potassium tablets containing a natural okra gum and other hydrophilic polymers, such as HPMC, in various concentrations can delay drug release and despite being hydrophilic in nature, can prolong the therapeutic effect for up to 12 hours, establishing its superiority over similar dosage forms. The delay in drug disintegration caused by compressive coating is aided. Solvent-free coating minimizes the hazards of using coating ingredients and equipment while also proving to be beneficial. Once the outer layer is entirely dissolved through the mechanism of swelling and polymer relaxation, the presence of super-disintegrant allows for a quick onset of action. The gum yields granules with good micromeritic properties and tablets with good physicochemical qualities, according to the characterization. Its usage in continuous release drug delivery systems has been successful due to its swelling and rate retardant properties. Some tablet formulations utilizing okra gum as a binder have good hardness, friability, disintegration time and dissolution rate. This binder, on the other hand, slows down the dissolving rate of some weakly soluble drugs, making it a good choice for prolonged release formulations. The lower concentration levels of okra, according to the findings, can be employed as an alternate binder to starch. Okra mucilage in greater concentrations has a delayed and sustained release and can be used as an alternative natural excipient in modified drug delivery systems. At the same time, when the binder concentrations of Hibiscus mucilage are increased, the above natural excipient of Hibiscus mucilage might be exploited as a platform for sustained release. Propranolol hydrochloride utilizes as a model drug and the activity of okra gum as a binder is compared by making tablets with hydroxypropyl methylcellulose (HPMC) and sodium alginate, respectively, as a synthetic and semisynthetic binder. When comparing sodium alginate and HPMC for drug release kinetics, dissolution studies show that okra gum retards

release by up to 24 hours and has the longest release time. Hardness and friability tests are also used to assess the tensile and crushing strength of tablets. Tablets made with okra gum have the highest hardness value and the lowest friability. As a result, okra gum trusted as a successful adjuvant in the production of palatable prolonged release tablets with high tensile and crushing strength. The mechanical properties of paracetamol tablets can be formulated with okra gum as binder at the concentrations used are similar to those of povidone, gelatin, and HPMC. Okra gum is superior to the three binders in its ability to reduce brittle fracture tendency in paracetamol tablets and because it can achieve very good drug release profile and mechanical properties at low binder concentration range (1.0%w/w to 2.0% w/w) it should be better explored and exploited as an alternative to povidone in tablet formulation since production would generally be cheaper; thus invariably leading to lower cost of tablet production. Okra gum has been utilized as a binder, hydrophilic polymer matrix, suspension, and bio-adhesive agents, among other things. The mucilage of the A. esculentus pods has been reported to exhibit tablet-binding capacity. In dental illness, A. esculentus has been found as a plasma expander, diuretic, and therapeutic agent. Plant mucilage has also been recognized as a tablet binder, in addition to its physiological functions. Only a limited investigation of the plant polysaccharide's applicability as a gel forming agent has been conducted thus far; consequently, the goal of this study was to assess the acceptability of okra polysaccharides as a gel-forming agent for the safe and effective delivery of pharmaceuticals via the nasal route.

- **As a suspending agent**

One of the most desirable properties for the creation of pharmaceutical suspensions is the ability to suspend. Mucilage yields from A. esculentus and A. moschatus are essentially identical in quality, therefore the suspension properties of the mucilage, such as sedimentation volume, flow rate, particle size analysis, pH and viscosity can be determined and mucilage can be utilized as a suspending agent.A esculentus pod mucilage may be submitted to a pre-formulation study to determine its safety and suitability for use as a suspending agent. When paracetamol suspensions compared to different concentrations of A. esculentus mucilage, tragacanth gum and sodium CMC (1%, 2%, 3% and 4% w/v). Mucilage is a superior suspending agent than tragacanth and comparable to sodium CMC in terms of

sedimentation profile, degree of flocculation, dispersibility and rheological behavior. According to studies, the mucilage of A. esculentus can be utilized as a pharmaceutical adjuvant and a suspending agent at 4% w/v, depending on its suspending capacity and suspension stability.Okra mucilage works wonders as a suspending agent in the drug delivery system. Okra mucilage has been used as a suspending and bio-adhesive agents.Okra mucilage has been used as a suspending agent in a variety of goods for decades in the food and confectionary industries. Okra mucilage's superior water solubility and rheological properties in the aqueous media have led to its use as a possible pharmaceutical excipient material in a variety of pharmaceutical dosage formulations.

- **As a floating agent**

Okra mucilage shown to be non-toxic, suitable and capable of being used in the development of floating drug delivery systems. Repaglinide gastro-retentive tablets can be made using a three-level factorial design with naturally occurring plant-based polymers and a synthetic polymer combination. The batches of such tablets show good floatability, swelling index and in vivo release properties. In vivo release studies demonstrate that formulating into a floating drug delivery system causes a decrease in the Ka and Ke, which is desirable for control release and the capacity to adjust pharmacokinetic behavior in the desired mode. In the development of controlled release dosage forms, plant-based polymeric can be a good substitute for synthetic polymers. Because of the matrix-forming ability of mucilage, Aesculentus fruit mucilage is one of the pharmaceutical excipients that allows for controlled drug release for a longer period of time by keeping the tablet floating in the gastric secretions. Because Abelmoschus gum is swellable, it can be used as a polymer in the development of a GRDDS alone or in conjunction with other polymers such as HPMC. However, the formulation using only a esculentus gum is extremely appropriate for making floating matrix tablets because it showed a longer-lasting releasing effect. It should be noted that A. esculentus gum has a substantially higher floating capacity and longer release time than HPMC E 15 polymer. Metformin HCl floating tablets with A. esculentus aid to increase the residence time of Metformin HCl in the stomach by providing optimal floating time. This

also helps to reduce the frequency of dosing, lowering the risk of side effects from Metformin, which is known to harm the kidneys. In recent investigation it is shown that Abelmoschus gum used as floating agent.

- **As a film coating agent**

Okra gum samples with low viscosity can be obtained using the innovative extraction approach, they can compare to those acquired using the classic extraction method. These samples are effective film coating agents, delivering more solids in less time than those made using the traditional method. In the aqueous tablet film coating operation, okra gum is a potential natural, biodegradable, inexpensive and environmentally friendly film former, especially when masking of flavor or disagreeable odor in a solid dose formulation is desired. Okra mucilage performs wonders as a film coating agent in drug delivery systems.

- **As an emulsifying agent**

Mucilage from the waste of A. esculentus can be extracted using two different solvents and a modified hot extraction method (Acetone, Methanol). In terms of possible applications, they are superior to seaweed polysaccharide. When compared to methanol (11.3 % and 0.28 %; EC % = 50 %), macro algae and okra waste have strong emulsifying power (EC % = 52.38 % and 54.76 %, respectively) with acetone (PH = 7). Okra is high in vitamins and minerals that aid in the normal functioning of the human biological system. Okra is a miracle medical vegetable that contains a wealth of nutrients and can be used to treat a number of disorders.Antioxidant, antidiabetic, antihyperlipidemic and antibacterial properties are all present in okra. Okra mucilage works wonders as an emulsifying agent in the drug delivery system.Mucilage from Abelmoschus containing information on an emulsifying property. Extraction of mucilage from Abelmoschus fruits or other plant parts, particularly from wild species, appears to be a profitable venture. One of the studies found that the okra plant might be used as an emulsifying agent in food emulsion systems

As a plasma expander

The use of okra gum as a plasma expander has been studied. As a result, local pharmaceutical manufacturers should take advantage of this low-cost, high-quality pharmaceutical excipient that has been examined(12). In dental illness, A. esculentus has been found as a plasma expander, diuretic and therapeutic agent.

- **As an antiadhesive**

To treat gastritis, traditional African and Asian medicine uses immature okra fruits as a mucilaginous food. Its efficiency is due to polysaccharides, which prevent Helicobacter pylori from adhering to stomach tissue. Strong antiadhesive effects are caused by non-specific interactions between high molecular components from okra fruits and the surface of H.pylori.

- **As a stabilizer**

A.esculentus mucilage is non-toxic and has the ability to act as a stabilizer(17). Both A. esculentus and A. moschatus have palatable mucilage that could be used as pharmaceutical adjuvants at lower concentrations (0.5-2 % w/v). Because of these characteristics, A. esculentus mucilage has been proposed for use as a stabilizer in the cosmetic, pharmaceutical, and food industries(15). Okra gum has been used as a foam stabilizer in a variety of products in the foodand confectionery industries in recent years(20). Okra gum is also employed as a viscosity supplementation agent in osteoarthritis treatment, tablet binding and disintegrating agentcontrolled drug delivery systems, slimming aids, nutritional foods and other transdermal drug delivery systems. Biodegradability, biocompatibility and easy availability of okra gum encourage most scientists to focus their work on it. Okra gum is an economical stabilizer.

- **As a thickner**

The cellulose and uronic acid-containing polysaccharides in okra mucilage can be acid hydrolyzed to produce l-arabinose, d- coat of L. sativum possesses thickening and gelling properties.

- **As an anti-oxidant**

Gemedetal in their study found that pods of okra accessions possess a desirable level of mucilage and are possible natural antioxidant sources(28). Fresh and dried okra seeds have higher protein (19.20 %) and lipid (12.72%) content than okra pods, which have protein (5.43 %) and fat (8.19 %). Antioxidant tests revealed that okra fruit and seed are high in phytochemicals. Okra is a rich source of natural antioxidants since it contains a high quantity of total flavonoids and a moderate amount of total phenolics. Okra pod and seed extracts should be considered as an antioxidant supplement to other products based on their antioxidant propertie

METHOD OF MODIFICATION :

There are many modification techniques including curing, blending except grafting but modification using grafting techniques shows better results because of an enhancement of their physical and chemical properties. When a comparison is made between the conventional closed vessel techniques and the microwave-based grafting techniques, the microwave-based techniques are better as the polymer gets easily modified. Grafted copolymers have more capacity to hold water. These are capable of being recognized in controlled and sustained drug delivery systems. Due to its biodegradability, polymers are non-toxic and compatible with body fluids. There are various patents that have been approved for the modification techniques as well as for the grafted polymer-based inventions. These grafted polymers are not only found useful in pharmaceuticals but can also be used in numerous fields. Grafting polyacrylamide with Okra mucilage, a polysaccharide of vegetable origin, results in novel polymeric materials with industrially useful characteristics. Using Acrylamide (AAm) and N, N-Methylenebisacrylamide (NN-MBAAm), a redox initiator system of CAN/HNO3 is

effectively applicable to graft and crosslink mucilage. The degree of grafting and crosslinking may vary dramatically depending on the monomer and initiator concentrations as well as reaction time and temperature. The grafting and crosslinking of acrylamide onto mucilage chains can be validated using several analytical techniques such as FTIR, SEM, and XRD patterns. The ability of crosslinked hydrogels to absorb water is affected by changes in pH. Because crosslinked polyacrylamides are non-biodegradable, utilizing polysaccharides to polyacrylamides improves the chances of biodegradable polymers forming.

CONCLUSION :

The data gave here demonstrate that okra is an essential vegetable crop that plays a variety of roles in drug delivery. Moreover, the polysaccharide content of the fruit has piqued the interest of research in the food and pharmaceutical industries. Furthermore, rather than being confined exclusively to the kitchen, this vegetable can be used as a vital tool in the prevention of many diseases.

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