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Review

Microcrystalline Cellulose: Inexhaustible Treasure

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	Abstract
Published on: 13 Apr 2025	<p>Microcrystalline cellulose (MCC) is emerging in popularity because of its renewability, non-toxicity, economic benefits, biodegradability, excellent mechanical properties, large surface area, and good biocompatibility. For instance, it is used in foods, pharmaceuticals, medicine, cosmetics, and polymer composites. MCC can be produced via several approaches, such as by reactive extrusion, enzyme mediated processes, steam explosions, and acid hydrolysis. It is widely utilized in tableting excipients as well because of its exceptional dry binding traits while undergoing direct compression. For particular industries, MCC's particle size, density, compressibility index, angle of repose, powder porosity, hydration swelling capacity, moisture sorption capacity, moisture content, crystallinity index, crystallite size and mechanical properties are determined in order to establish applicability for the industry. Thermogravimetric analysis (TGA) and differential thermal analysis (DTA) or differential scanning calorimetry (DSC) is typical of measuring MCC, these dimensions then allow for the predication of the thermal behaviour of MCC when subjected to different heat stresses. For nanocrystalline cellulose, the degree of polymerization of MCC is usually over 400 while for MCC is less than that. Maximum mass fraction of 10% of all particles must consist of MCC particles sized lower than 5µm. There are several subclasses of MCC such as PHs 101, 102, 103, 105, 112, 113, 200, 301, and 302 which can be categorized according to their size.</p>
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	<p>Keywords: Microcrystalline cellulose (MCC), Thermogravimetric analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC)</p>

INTRODUCTION

The pulp of fibrous plant material is the source of microcrystalline cellulose (MCC), a highly depolymerized form of cellulose that usually has fewer than 400 polymerization numbers and less than 10% of its

particle size below 5 millimetres. It is included into dispersants, stabilizers, emulsifying agents, and anti-caking agents. MCC, which has the molecular formula C₆H₁₀O₅, was recently made from α -cellulose using acid hydrolysis (H₂SO₄). In a nutshell, this is a linear chain of D-glucose units connected between positions 1-4, ranging from a few to over 10,000 glucoses [1]. The majority of MCC sources that are appropriate for use in medicinal applications are made of wood, cellulose-strand filaments, lignin, and hydrogen-bonded stacks. Cotton linters, cottons talks, cotton rags, cotton fabric waste, cotton wools, defence husk, corn cobs, water hyacinth, coconut shell, oil palm waste, oil palm fronds, rice husk, sugar cane bagasse, jute, ramie, flax fibers and straw, wheat husks, sorghum straw, sisal fibers, mangosteen, alfalfa grass fibers, soybean hulls, orange mesocarp, Indian bamboo, roselle fibre, and alfalfa fibre are non-wood-based low-grade materials that are derived as sources of MCC. These materials have layer-on-layer chain packing, with cellulose chains connected by intramolecular and intermolecular hydrogen bonds [2].

Synonyms for MCC

- Cellulose, Regenerated
- Microcrystalline cellulose
- Cellulosum microcrystallinum
- Avicel PH
- CCRIS 6600
- Cellulose, Microcrystalline (II)
- Cellulose microporous
- CP-305
- Cellulose powders
- Celphere CP-305
- Microcrystalline cellulose (E460)

Synthesis and manufacturing process of MCC

Microcrystalline cellulose (MCC) is a multipurpose material whose manufacturing process—which includes extrusion, steam explosion, enzyme-mediated processes, and acid hydrolysis—depends on its intended use. Despite being a batch-type process, acid hydrolysis is more desirable than the others due to its length and continual application. Because fewer chemicals are used, the MCC result is purer and costs less overall [3]. This process uses high pressure and temperature to hydrolyse fibrous plant pulp into microcrystalline acid. Cellulose polymers are broken down into tiny crystals by this kind of acid. Hemicelluloses, beta and gamma celluloses, and other lignin constituents are eliminated during the ensuing washing and filtering process. A white, slurred solution is then created by converting the resulting pure alpha cellulose into a hydroxide state. MCC is created when the finished product dries and becomes a white powder with no flavor or Odor. MCC exhibits hygroscopicity and water insolubility as a compound, causing swelling when it comes into touch with water. revealed another method of MCC synthesis that uses hydrochloric acid to hydrolyse α -cellulose for 15 minutes at a boiling temperature of 105 degrees. One technique that is frequently used to dry the MCC slurry is spray drying. After the hydrolysis process, the neutralized slurry is cleaned and then the fraction that passes through a 710 μ m filter is placed in a desiccator at room temperature.

The final properties of the product can be changed by adjusting the spray drying conditions. Numerous research on MCC have been conducted worldwide, with an emphasis on diverse product forms from different producers in various locations [4]. The moisture content of the MCC affects its viscoelastic properties, tensile strength, and compaction properties. In order to separate the crystalline material from the non-crystalline material, cellulose is partially hydrolysed. High-grade cellulose, which can be obtained from wood pulp or bleached cotton linters following thorough cleaning to remove lignin, hemicellulose, and other impurities, serves as the foundation for MCC. The bigger amorphous cellulose is broken down into smaller, crystalline pieces by the acid hydrolysis process. The acid is then removed and the material's pH is raised using soft reagents like sodium hydroxide in the washing and neutralization processes that follow. Wet and dry variants of MCC are other classifications. Filtration and centrifugation are two methods that may be used to eliminate the excess water in the wet MCC. Spray drying and drum drying can produce fine, dry MCC powder, which can then be ground into flakes. Using a milling process and sifting to ensure even dispersion, the dry MCC is ground into the appropriate particle size. Solubility can be improved via surface modification. The finished product is packed in moisture-resistant containers after being examined for purity, moisture content, crystallinity, polymerization degree, and particle size distribution [5].

Types of MMC

There are two types of microcrystalline cellulose. They are,

Powered MCC

Milled and refined microcrystalline cellulose (MCC) with a free-flowing texture due to its lower particle size is referred to as MCC powder. Because of its flexibility, MCC powder, which is made from wood pulp and partly depolymerized cellulose, finds use in a wide range of industries, including food, cosmetics, and medicines. Because it swells when submerged in water, it has better binding qualities, which is why it is used as a binder. Purified cellulose, a polysaccharide composed of beta 1:4 (D-glucose) units, makes up its chemical makeup. It is a chemically inert and thermally stable substance under normal circumstances since it dissolves in water but is insoluble in both organic solvents and water. MCC powder's free-flowing properties have improved a number of goods, including texture-enhancing and non-dietary bulking agent excipients in tablets and treats. It has also been used as a flowing agent in manufacturing operations to improve the flowability of powder due to its fine quality. Rubbers, polymers, varnishes, and paints are just a few of the many uses for powdered MCC [6].



Fig 1

Colloidal MCC

Colloidal Microcrystalline Cellulose (CMCC) forms a microcrystalline cellulose which is processed into a fine colloidal suspension. The composition consists of microcrystalline cellulose combined with Carboxymethyl cellulose (CMC), which acted as a stabilizer. This endows the product with exceptional properties suitable for all kinds of stabilizing, thickening, and suspending processes. The CMCC particles are characterized by very small size that are highly dispersed, a structure that is preserved, as well as water soluble. Taste and Odor are neutral and non-toxic together with being biocompatible. Its applications cross the pharmaceutical, food production, cosmetic, and even industrial industries. In pharmaceuticals, CMCC is employed in oral suspensions, creams, gels, and even eye drops for their thickening and stabilizing effect. In food industry, dairy products, sauces, dressings, and beverages utilize CMCC to improve preservation and texture. While in cosmetics, lotions, creams, and liquid make ups achieve improved consistency. Industrial applications include paints, coatings and adhesives which require better viscosity and suspension. The advantages of CMCC include improved stability of products for longer periods, uniform and consistent formulations, and compatibility of varying pH and other additives. CMCC is manufactured by means of mechanical treatment which is carried out through friction and extremely forceful rotary shear. This technique breaks down the compacted cellulose fibre clumps, creating micro-crystals in the process. In conclusion, colloidal MCC compounds possess desirable properties such as thickness, elasticity, compatibility, and viscosity, making them suitable for various food, pharmaceutical, and cosmetic applications [7].



Fig 2

Types of commercial microcrystalline cellulose

Table 1

MCC Type	Particle size (micron)	Utilization
PH 101	50	It is most widely used for direct compression tableting, for wet granulation, for spheronization, and in capsule filling processes
PH 102	100	It is used as the PH-101, but its larger particle size improves the flow of fine powders
PH 103	50	It has the same particle size as PH-101 with lower moisture content (3%), so it is used for moisture-sensitive pharmaceutical active ingredients
PH 105	Less than 50	It is the most compressible of the PH products owing the smallest particle size. Well known as excipient for direct compression for granular or crystalline materials. When mixed with PII-101 or PII-102, specific flow and compression characteristics will be obtained. It has applications in roller compaction
PH 112	100	It has the same particle size as PH-102. It has lower moisture content (1.5%). It is used for high moisture-sensitive pharmaceutical active ingredients
PH 113	50	It has the same particle size as PH-101. It has lower moisture content (1.5%). It is used for high moisture-sensitive pharmaceutical active ingredients
PH 200	180	It has a large particle size with increased flowability. It is used to reduce weight variation and to improve content uniformity in direct compression formulations and in wet granulation formulations
PH 301	50	It has the same particle size as PH-101 but is denser providing more flowability and tablet weight uniformity. Useful for making smaller tablets and in capsule filling excipient

Physicochemical properties

There are some key physicochemical properties

Appearance: were discovered to be white, tasteless, and odourless [8].

Bulk density: Bulk volume and density were measured by draining a 10-gm unmodified and modified MCC into a 50 mL measuring cylinder. Each sample's tapped volumes were calculated following 200 taps. Weight was divided by volume to determine the tapped density. After three iterations of the experiment, the average value together with the standard deviation was determined [9].

Biodegradable: A naturally occurring, non-toxic biopolymer made from plant cellulose is called microcrystalline cellulose (MCC). Environmental microbes have the ability to break it down into simpler substances like glucose. However, formulations and environmental factors including moisture, temperature, and the presence of microorganisms determine its destiny in the environment [10].

Compressibility: MCC is a very compressible filler that has minimal lubrication sensitivity, plastic deformation, and a high dilution potential. Particle size, shape, moisture content, and formulation parameters are some of the variables that affect compressibility. MCC is essential for stability and resistance in tablet hardness and direct compression tableting [11].

Mechanical strength: Because of its great mechanical strength, microcrystalline cellulose (MCC) is an essential ingredient in pharmaceutical tablets. It can produce thick, sturdy tablets because of its low lubrication sensitivity, plastic deformation, and compressibility. Particle size, moisture concentration, and formulation variables all affect how strong MCC is. For stability and integrity, MCC is utilized in controlled release formulations and direct compression tableting [12].

Solubility: Microcrystalline Cellulose (MCC) has a minor swelling in strong alkaline solutions but is normally insoluble in water, diluted acids, alkalis, and most organic solvents [13].

Viscosity: Because MCC makes aqueous solutions more viscous, it can be used as a thickening, stabilizer, suspending agent, and thickener in the food, pharmaceutical, and cosmetic sectors [14].

And some important properties of MCC are: Colloid formation, adhesion, size of the particle and PH etc...

Pharmaceutical applications and uses of mcc

The MCC is utilized in medicines in a number of ways, including:

Binders

Microcrystalline Cellulose (MCC) is a versatile binder that plays a crucial role in tablet manufacturing due to its hydrophilic properties. It enhances binding in the water-efficient tablet compression process and is often used in coating placebos. MCC is not typically used as a binder due to its high cost, but it is economical and widely used in coating placebos. MCC blended with Avicel can be used for magnesium stearate in hard gelatine capsules as a diluent elastomer [15]. It can also be applied during wet granulation of both removable and non-removable powders, preventing aging hardening and preventing aging hardening. In moist granulation, MCC's

high water absorption ability facilitates quick and even wetting of powder mixes. Because of its low residual die wall pressure and low friction coefficient, MCC is a self-dispersing binder with little lubricant need. It does not, however, do away with the necessity of actual lubricants and disintegrants. For quick disintegration, MCC is combined with super disintegrants in tablet formulations. It is given to producers, is easy to handle, and is medically inert. Spray-dried lactose is one of the least compressible materials among the most immediately compressible fillers, according to MCC's compression characterisation [16]. The addition of 2.5% Avicel to the mix demonstrated that MCC had fulfilled its function.

Spheronizing agent

In order to transform medications into spherical-shaped tablets, MCC is a highly sought-after excipient in the production of multiarticulate pellets employing extrusion spherization. Because it produces distinctive, spherically shaped drug-loaded pellets, it is an advance over the traditional technique of drug stacking onto pellets. Previously, the product was known as extrudates. It belongs to the class of non-rigid plastics that aggregate into enormous, spherical balls. For the formulation mixture to flow well through the die without clogging and to maintain its original shape after extrusion, it must be cohesive and malleable. In the spheronizer, the plastic must be sufficiently flexible to roll into balls while still being robust enough to avoid clumping together and creating a stiff finished spherical [17]. MCC can work wonders in formulation, particularly with Avicel PH-101. MCC functions like a molecular sponge, absorbing water that has been added to the mixture. It works well as an excipient for extrusion spherization. During the spherization process with auto adhesion, this feature alters the wet mass's rheological properties and raises its tensile strength. Avicel® PH-101 or PH-102 is especially recommended for this procedure since it can increase the sphericity of the pellets while reducing spheroid fracture and over wetting of the spheres. It is possible to reduce process sensitivity across the whole manufacturing process. In conclusion, MCC is a useful excipient that provides a distinctive and effective substitute for conventional drug stacking in the creation of multiarticulate pellets by extrusion spherization [18].

Disintegration

Microcrystalline cellulose, or MCC, is frequently used to make tablets with the goal of speeding up the breakdown of the tablet structure and aiding the drug's solubility. They can be used as water mouthpieces or as tablet destroyers, breaking down tablets into tiny pieces to reveal more surface area. Because of its excellent water wicking ability and poor elastic characteristics, Avicel derivative is typically used to break down tablets. Nevertheless, it has the drawback of generating static charges as a result of water absorption, which might lead to granule striations or fractures. Avicel is frequently dried before being used in the formulation in order to reduce the amount of moisture [19]. Approximately 90 to 95 percent of the surface area of Avicel is internal, indicating a very high intraparticle porosity. Along with tablet breakdown via capillary action through the pores and hydrogen bond destruction, this mechanism also helps to promote swelling. A higher compaction pressure causes less water to enter the tablets, lengthening the time it takes for the water to dissolve. Since the amorphous portion of the MCC is more hydrophilic than the crystalline portion, water can only be soaked in it. The amount of sorbent water is independent of surface area and directly related to the percentage of amorphous material in the MCC crystallinity. The pill dissolves when the disintegrators expand and dissolve when they are hydrated [20]. In oral disintegrating tablets, Avicel has been used as a dissolution enhancer and effervescent penetration enhancer. In this system, by performing dry granulation, Avicel acts as a disintegrant in a concentration of 5.20%.

Lubricant

The medication Avicel has a very low coefficient of friction because it requires very little lubrication. Mostly when lubricant is added, it works well for other medicine excipients as well as when capsules and tablets are being formed. Additionally, the presence of additional lubricant prevents the chemicals from clumping. However, using these types of lubricants in direct compression formulations may impact the tablet's hardness. Lubricants with a hydrophobic basis will guarantee effective mixing throughout the granulation process and both shorten and lengthen the dissolution and disintegration times. The enhanced lubricant coating of the granules results in less binding during compression. Its application is deemed suitable for Avicel. Avicel has so low static and dynamic friction that it is utilized as a lubricant. However, lubrication becomes essential after the amount of medication + additional excipients surpasses 20% [1].

Glidant

Glidants are among the several excipients that are added to oral solid formulations in order to improve the powder flow character by decreasing inter-particulate friction and cohesion. Both silica-based and non-silica-based glidants are often used in tablet compression as flow promoters, including silicon dioxide, hydrated sodium chloroaluminate, and silica hydrogel. One example of an MCC with excessive functions granted to a formulation is Prosolv, a type of MCC with great efficacy that allows for distribution, compression, and passing. The three

grades of Prosolv SMCC®—Prosolv SMCC 50, SMCC 90, and SMCC HD 90—are distinguished by bulk density and particle size. They provide interesting, uniform, and reasonably priced chemical tablets with better flowability, mixing qualities, reduced disintegration time, and less requirement for excipients [21]. Improved dust-free and compatibility. In a compaction simulator, recent research showed that silicified MCC and MCC make good plugs in hard gelatin capsule shells. Prosolv SMCC® is an excipient for direct compression that can significantly reduce the excipient quantities and levels by doing away with the granulation stage entirely. Because to their varying average particle sizes and bulk densities, the products offer several advantages, such as better mixing and flow characteristics, cheaper manufacturing costs due to the need for fewer excipients, and shorter disintegration times. Because silicified MCC and MCC are effective plug formers, they can help lower production costs and increase product manufacturing efficiency [22].

Advantages

Benefits and Applications of Microcrystalline Cellulose in Medicine.

In the pharmaceutical sector, microcrystalline cellulose (MCC) is a flexible substance that is employed in a number of procedures. They are:

- It is a common texturiser in cosmetics and an anti-caking agent in processed foods.
- MCC's compressibility properties make it useful in solid pharmaceutical dosage forms like tablets.
- It is chemically pure, safe for use in pharmaceutical and food products, and has remarkable flowability, making it versatile for use in a variety of capsules and tablets.
- MCC is also a great bio adhesive and used in bio adhesive drug delivery systems [23].

Disadvantages

- Hygroscopic qualities that cause moisture absorption and a decrease in toughness.
- One drawback of certain big particle microcrystalline celluloses might be their heightened susceptibility to an additional lubricant, which would reduce the tablet's strength.
- Additionally, the drawback is accompanied with segregation.
- When functionality is modified, it also changes.
- It has a limited potential for dilution.
- Reworkability.
- The API's compressibility is low for microcrystalline cellulose.
- It is sensitive to lubricants [24].

Handling precautions

Combustible dust is one among the risks associated with handling MCC in laboratories. Therefore, the main safety requirements are to wear personal protective equipment (PPE) after assessing the hazard/risk assessment, make sure there is enough ventilation, prevent dust from forming, and prevent it from getting into direct contact with the skin, eyes, or clothes. In situations where there is inadequate ventilation or severe dust production, provisions should also be established for the use of respirators or dust masks [25]. Minimizing dust production, using "gentle" handling methods, maintaining cleanliness, practicing excellent hygiene, and using ventilation are all part of handling duties. Packaging materials that are no longer needed should be disposed of right away in a hazardous waste container or similar container. It is advised that handling and storage be done in a cool, dry, well-ventilated area away from heat sources and sun light. Since MCC is an ignitable dust that doesn't serve as a fuel source for dust clouds, it is crucial to have fire protection in place in fire safety cases—not simply in case combustion becomes uncontrollable. There should be extinguishers on hand, like as carbon dioxide or dry chemicals. Emergency procedures include flushing the eyes with water for about fifteen minutes, washing the afflicted area with soap and water if it comes into touch with the skin, breathing in fresh air, or, in the unlikely event that it is consumed, rinsing the mouth with water and drinking water [26]. When in uncertain, get advice on how to manage your MCC and workplace safety laws from a qualified industrial hygienist or safety expert.

Storage

Stable microcrystalline cellulose has a large capacity to absorb atmospheric moisture. It should be kept in a cold, dry location in a well-sealed container to preserve its quality. It has a three-year shelf life with a 12-month extension. To avoid moisture and dust, keep it securely covered and out of direct sunlight and heat sources. To preserve the quality of the product, keep it in its original container. Steer clear of strong oxidizers [27].

Incompatibilities

Microcrystalline cellulose (MCC) is most incompatibility with strong oxidizing agent. However, it is important to understand potential incompatibilities to ensure successful formulation development. MCC-formulated poorly soluble drugs can prevent contact with the dissolution medium, so recommendations include particle size reduction, surfactants, co-processing, and preventing moisture accumulation. Other factors like drug attributes, formulation considerations, manufacturing process, and storage conditions also impact MCC compatibility [28].

To mitigate incompatibility risks, preformulating studies should be executed, evaluating the drug's physical and chemical stability in the presence of MCC under different storage conditions. Dissolution studies show the rate of drug release from the formulation with MCC, while hygroscopicity studies suggest alternative solutions to control moisture. Formulation optimization should include ingredient selections that work with both API and MCC [29].

To reduce MCC deterioration and ensure consistent product quality, the production process should be improved, and stability testing should be a key component of quality control procedures. Dissolution testing should be done for each batch until the product's final shelf life. In conclusion, proper formulation creation requires awareness of MCC's potential incompatibilities, and a thorough pre-formulation research, formulation optimization, and a strong quality control system can help decrease the risk of incompatibility.

Adverse effects

- In general, microcrystalline cellulose has no significant negative consequences. However, its effects are minor and infrequent: they are:
- Diarrhoea
- Bloating
- Discomfort in stomach
- Gas formation
- Allergic reactions like rashes
- Increased bowel movements
- Irritation of skin

Evaluation**Assay**

A good-mixed reagent is needed for the microcrystalline cellulose (MCC) assay test. The method verifies whether the cellulose content in a sample is in compliance with the intended target in accordance with the stipulated purity norms. The test is customary for MCC with pharmaceutical applications to evaluate the standardization and certitude of its purity as per factual established segmentation boundaries and explicatively good so as to be suitable for incorporation into the marketed product. Assay methodology and its acceptance criteria vary according to monographs under referenced pharmacopeial standards like the American Pharmacopeia (USP) and European Pharmacopeia (Ph. Eur.). To sum up, the MCC assay test is essential for guaranteeing the calibre and uniformity of MCC utilized in pharmaceutical formulations. It assists in confirming that the product satisfies the necessary purity standards and is appropriate for use in pharmaceutical goods [30].

pH

The pH for most types of Microcrystalline Cellulose (MCC) falls within 5.0–7.5. The study followed up on the relationship between the pH and the rheological properties of an F11 aqueous dispersion at varying values. The two values were nearly independent of γ in the range pH 3.31–6.77, but a decrease in pH further expanded the difference between the σ values at 2.90 or below. The modulus G' was nearly independent of γ at lower γ but with high values at pH 2.90 or below. For G' at higher γ , it appears that it is slightly decreasing at increasing γ values and thereby approaching the values similar to 3.31–6.77 pH, indicating that the aggregate structure of MCC particles is strengthening with falling pH, easily fracturing under pronounced deformation [31].

Loss in drying

The loss on Drying (LOD) test is a prime quality control parameter aimed at assuring the quality and consistency of Microcrystalline Cellulose (MCC). It measures the moisture content contained in a sample—this is a measure that affects the stability of the product, the flowability of the product and its acceptance in different environments, the release of the product, and so on. For LOD, take 1.000 g of substance and weigh it in a clean, dried pre-weighed LOD Bottle, seal the stopper, give a good shake to distribute the material equally up to six, to 10 mm height in the LOD Bottle, put the LOD Bottle inside the oven, and leave it in the oven maintenance temperature of 100-105°C for 3 hours. After drying, keep the sample in desiccators and bring the content to room temperature. The pharmacopeial standards establish the acceptable limit for LOD of MCC; normally, this is

represented by a typical value that is not to exceed 7.0%. The main factors influencing LOD are the conditions of storage, high humidity, temperature variations, and the processes used in manufacturing [32].

Particle size analysis

Particle size distribution and its impact on various physical and functional properties of Microcrystalline Cellulose (MCC). It will also discuss the implications of the particle-size reduction for flow, compression, dissolution rate, and disintegration in tablet formulations. Techniques for particle size distribution measurement include Laser Diffraction, Dynamic Light Scattering (DLS), Sieve Analysis, and Scanning Electron Microscopy (SEM), all of which provide rapid and accurate distribution analyses spanning a wide range. Particle size distribution is usually presented in terms of average particle size, median particle size, and span. Indeed, the examination is crucial to ensuring the optimal quality, ensuring that this pharmaceutical excipient performs efficiently, the selection of a specific grade for specific applications, as well as optimization of formulation and processing parameters. A good array of techniques like Laser Diffraction, Dynamic Light Scattering, Sieve Analysis, and Scanning Electron Microscopy can give valuable information about its particle size, shape, and surface morphology [33].

Flow ability test

When choosing the proper grade of Microcrystalline Cellulose (MCC) for pharmaceutical manufacture, particularly in the creation of tablets and capsules, flowability studies are essential. Inconsistent powder flow, weight fluctuations, capping and lamination flaws, and decreased manufacturing efficiency can all result from poor flowability. The Angle of Repose, the Hausner Ratio, Carr's Index, Shear Cell Tests, and Vibration Shear Tests are typical flowability tests for MCC [34]. These tests determine the powder's compressibility index, shear cell strength, vibration shear tests, bulk density to tapped density, and stability of a pile of powder. Electrostatic charge, moisture content, and particle size distribution are additional variables. According to research, the Avicel PH102 batch of MCC had the minimally acceptable flow characteristics needed for high-speed tableting to be effective. Batch-to-batch flow functions did not differ significantly at a 95% confidence level, and the measured flow function was independent of operator, indicating satisfactory repeatability [35].

Marketed products

Brand Names	Company Names
Avicel	Dupont pharma
Emcocel	JRS pharma
Vivapur	JRS pharma
Pharmacel	DFE pharma
Microcel	Roquette pharma

Medications contains microcrystalline cellulose and dose

Medications	Dose of MCC
Acetaminophen and hydrocodone bitartrate	5mg, 7.5mg, 10mg,
Acetaminophen and oxycodone hydrochloride	5mg, 10mg
Alprazolam	0.5mg, 1mg, 2mg
Amphetamine and dextroamphetamine	30mg
Cyclobenzaprine hydrochloride	10mg
Oxycodone hydrochloride	5mg, 10mg, 30mg
Lortab	10mg

CONCLUSION

Alpha cellulose is acid-hydrolysed to create microcrystalline cellulose (MCC), a refined, partly depolymerized cellulose. Because of its excellent dry binding qualities, it is a useful addition in food, medicine, and cosmetics. Although there are other methods for creating MCC, the acid hydrolysis method is recommended because of its quicker reaction time. Drying techniques include desiccation using silica gel, fluid-bed drying, hot air oven drying, and freeze-drying. Nuclear magnetic resonance, atomic force spectroscopy, scanning electron microscopy, transmission electron microscopy, hi-resolution transmission electron microscopy, X-ray diffraction, thermogravimetric analysis, differential thermal analysis or differential scanning calorimetry, and infrared

spectroscopy are some of the methods that can be used to characterize MCC. MCC comes in a variety of forms, but PH 101 is most frequently utilized for spheronization, wet granulation, direct compression tableting, and filling of the capsules. By verifying that the product satisfies the required purity criteria and is suitable for use in pharmaceutical products, the MCC assay test guarantees the quality and consistency of MCC used in pharmaceutical formulations. A food-grade substance called Avicel® RC/CL is combined with sodium carboxymethylcellulose. In tablet formulations, especially for making tablets and capsules, microcrystalline cellulose (MCC) is utilized. At lower γ , the modulus G' is almost independent of γ , but at pH 2.90 or below, it has large values. The pH varies from 5.0 to 7.5. The moisture content of a sample, which influences the product's stability, flowability, acceptability in various contexts, and release, is measured by the loss on drying (LOD) test. for selecting the right grade of MCC for pharmaceutical manufacturing, especially for making tablets and capsules, flow ability testing are crucial. Wearing personal protective equipment, making sure there is enough ventilation, avoiding dust buildup, and keeping it out of the lab are all part of the safety regulations.

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