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GUANGXI AGRIBUSINESS GROUP CORPORATION

明阳淀粉
MINGYANG STARCH

Cassava starch processing technology and its application in China

中国木薯淀粉加工技术及其应用

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Tapioca Industry Situation in China中国木薯淀粉产业情况

Cassava, as one of the world's three major tuber crops, is a non-food resource with many excellent natural characteristics, such as wide suitability, drought resistance, barrenness resistance, easy cultivation, etc. Currently, China's domestic planting area has been declined, with statistics in 2020 at about 300,000 hectares and fresh cassava production of about 5-6 million tons, with planting areas in Guangxi, Guangdong, Hainan, Yunnan, Fujian and Jiangxi, etc. of which Guangxi cassava planting area and fresh cassava production accounted for more than half of the national total.

木薯作为世界三大薯类作物之一，属于非粮资源，具有许多优良的天然特性，如适性广、耐干旱、耐贫瘠、耐粗放、易栽培等特点，目前中国国内种植面积有所下降，2020年统计数据在30万公顷左右，鲜薯产量约为500-600万吨，种植地区分布在广西、广东、海南、云南、福建和江西等地，其中广西木薯种植面积及鲜薯产量占到了全国总量的一半以上。

At present, China's cassava starch production shrinkage is more serious, but the downstream demand increases tremendously. The apparent demand in 2020 was more than 3 million tons, with cassava modified starch demand from various industries exceeding more than 1.7 million tons. Due to the undersupply of domestic cassava starch raw material, the huge supply gap needs to be plugged by importing from Southeast Asia, and the rate of China’s dependence on foreign market in terms of cassava starch is up to 91%.

目前中国木薯淀粉产量萎缩较为严重，但下游需求增幅巨大，2020年统计的表观需求量超过了300万吨，各行业对于木薯变性淀粉需求超过170万吨，由于国内木薯淀粉原料供应不足，巨大的供应缺口需要同过从东南亚地区进口，中国市场木薯淀粉对外依存度高达91%。

Cassava ecological cycle industrial chain in China
中国木薯生态循环产业链

Contents

01

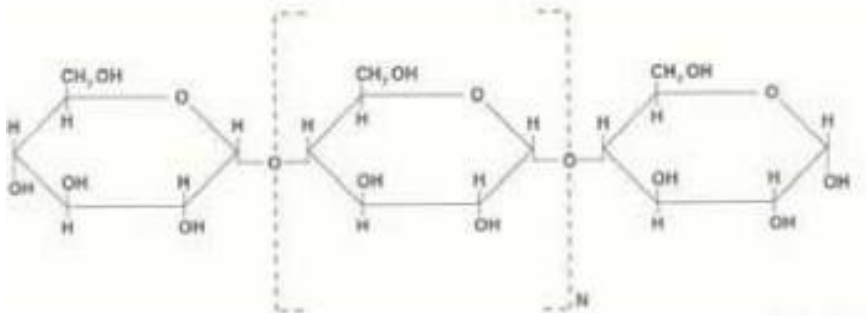
The source of starch

What is starch 什么是淀粉?

Starch is 淀粉是

"a white, odorless, tasteless carbohydrate in the form of granules or powder that is the primary storage of plant carbohydrates, an important foodstuff, and can be used as binder and paste in laundry and medicine..

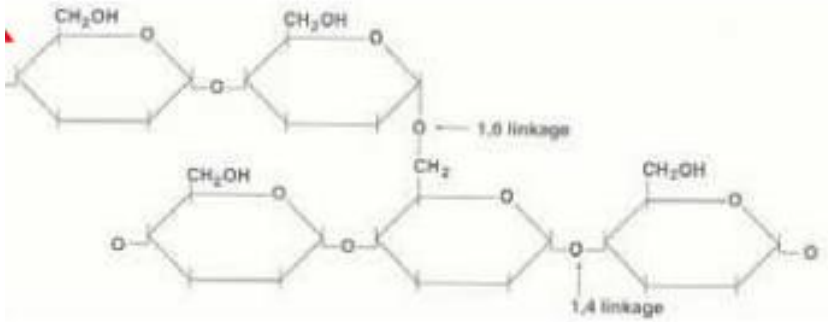
“一种白色、无臭、 无味的颗粒或粉末形的碳水化合物，是植物碳水化合物的主要储存方式，一种重要的食品，在洗衣、医药中也作为粘合剂与浆糊. ”



amylose

Two types of starch polymers exist in nature - amylose and amylopectin

自然界存在两种淀粉聚合物形态——直链淀粉及支链淀粉



amylopectin

The source of starch
淀粉的来源

• common corn（grain）普通玉米（谷物）

• waxy corn （grain, with more than 99% amylopectin）
蜡质玉米（谷物，99%以上的支链淀粉）

• high-amylose corn （grain, it refers to products with more than 50% amylose content that is incompletely gelatinized at room temperature ）
高直链玉米（谷物，指直链淀粉含量超过50%以上的产品，常温不完全糊化）

The source of starch

•wheat(grain)小麦(谷物)

•rice（grain）大米（谷物）

•potato(tuber) 马铃薯(根茎)

•cassava(tuber） 木薯(根茎）

The source of starch

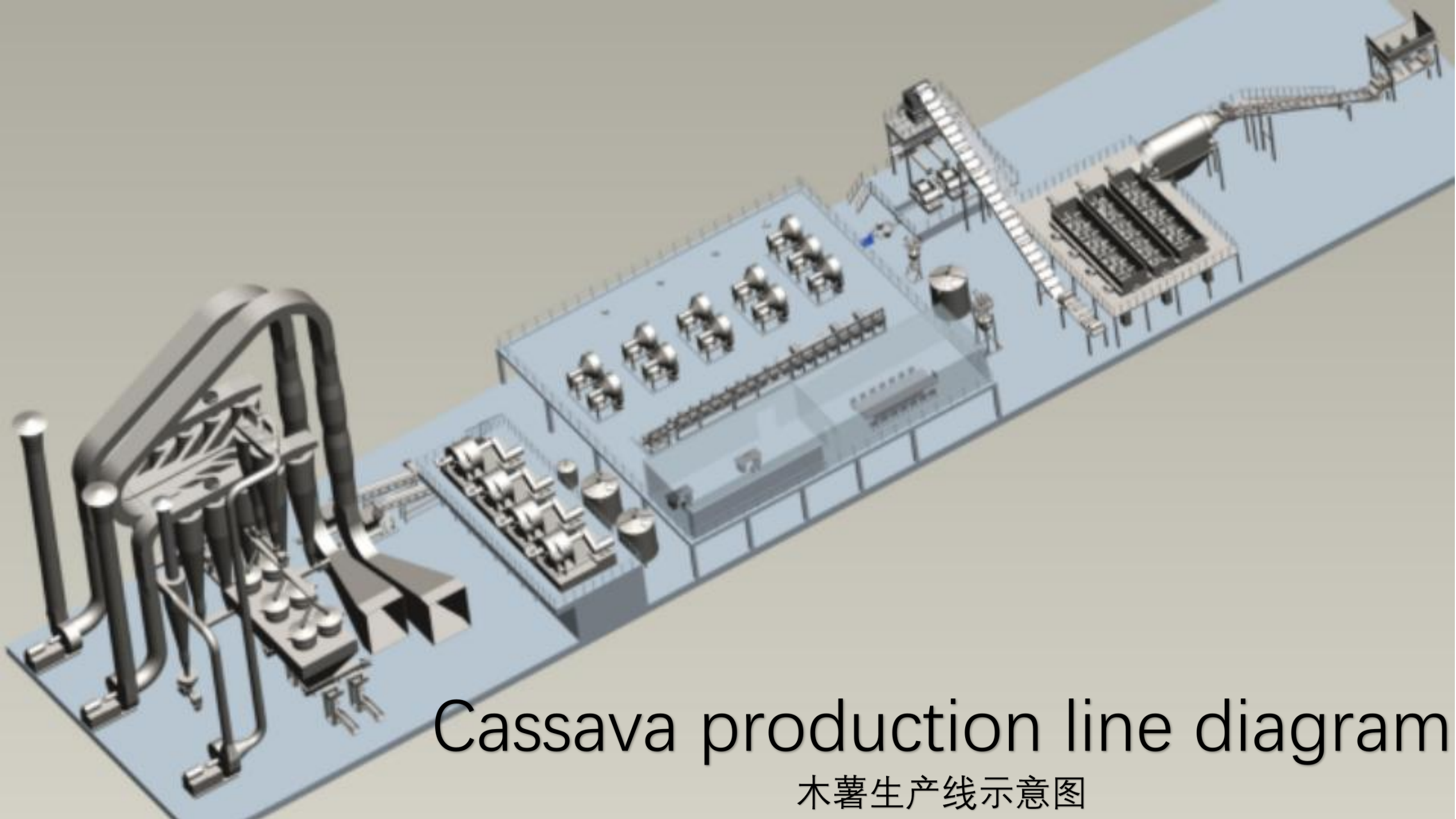
•sago（bole）西米（树干）

•pea（beans）豌豆（豆类）

Appearance of starch淀粉的外观

- **Visual appearance：small white powder, odorless** 直观：细小的白色粉末，无气味。
- **Micrographs: diameter of particles from 5 μm to 100 μm; with Maltese cross in polarized light**显微照片：粒径从5m至100m；偏振光下具有偏光十字

	diameter of particles粒径 （m）	Micrographs of particles颗粒显微外观
potato马铃薯	5-100	oval卵形、椭圆形
cassava木薯	4-35	circle, one end of the circle is truncated圆形、一端被截去
corn玉米	2-30	circle, polygon圆形、多角形
wheat小麦	2-35	circle圆形
rice大米	3-8	polygon多角形
waxy corn蜡质玉米	3-26	circle、polygon圆形、多角形



Cassava production line diagram

木薯生产线示意图

Processing of tapioca:木薯淀粉的加工

raw material feeding, washing, peeling——原料进料洗选剥皮

The cassava roots are transferred to the root hopper and then its dirt will be removed by a rotating slotted drum and finally the clean cassava roots are fed into the washing tank.

木薯根部被转移到根部料斗，并通过旋转的开槽滚筒清除污垢, 将清洁的木薯根喂入洗涤槽

Processing of tapioca:木薯淀粉的加工
grinding, starch extraction——粉碎、淀粉提取

The cassava roots are lifted by the paddles of the washing tank. Then, the peel is removed from the cassava roots. The peeled cassava roots are cut into 1-2 cm of pieces by a cutting blade and fed into a serrated grinder, either vertically or horizontally, whose fibers are removed by conical screen in continuous centrifugal perforated basket. Recently, extractors equipped with curved screens have been introduced to improve filtration efficiency. The starch slurry from the coarse extractor that crosses filter cloth and sieves with apertures of 150 microns (100 meshes) to 125 microns (120 meshes) still contains a large amount of fibers that must be removed in the fiber extractor equipped with a sieve whose apertures range from140 to 200 meshes.

木薯根则通过洗涤槽桨叶的作用被抬起。后一阶段从木薯根去除果皮。通过切割刀片将根切成1-2厘米的块状物，并将其送入锯齿状的粉碎机中，可以是垂直的或水平的，其中纤维通过在连续离心式穿孔篮中锥形排列的筛网移除。最近，引入了配备弯曲筛网的提取器以提高过滤效率。离开粗提取器的淀粉浆料配有滤布和孔径为150微米（100目）至125微米（120目）的筛网，仍然含有大量的纤维，必须在装有a的纤维提取器中除去。筛网（140-200目）。

Processing of tapioca:木薯淀粉的加工

refinement、concentration——精制、浓缩

In each extraction stage, the desanding hydrocyclone will be used to ensure the sand removal. Additional filters, such as rotary brush filters, are installed to prevent the starch clumps. Repeat the extraction of the pulp from the coarse extractor to minimize the loss of starch captured in the wet pulp (moisture content of 60-70%, dry basis, containing 45-55% starch).The starch pulp collected from the feedstock is extracted at a concentration of 20-35% (10-17˚Be'). The starch slurry is further concentrated to 40% (20˚ Be') by a hydrocyclone.

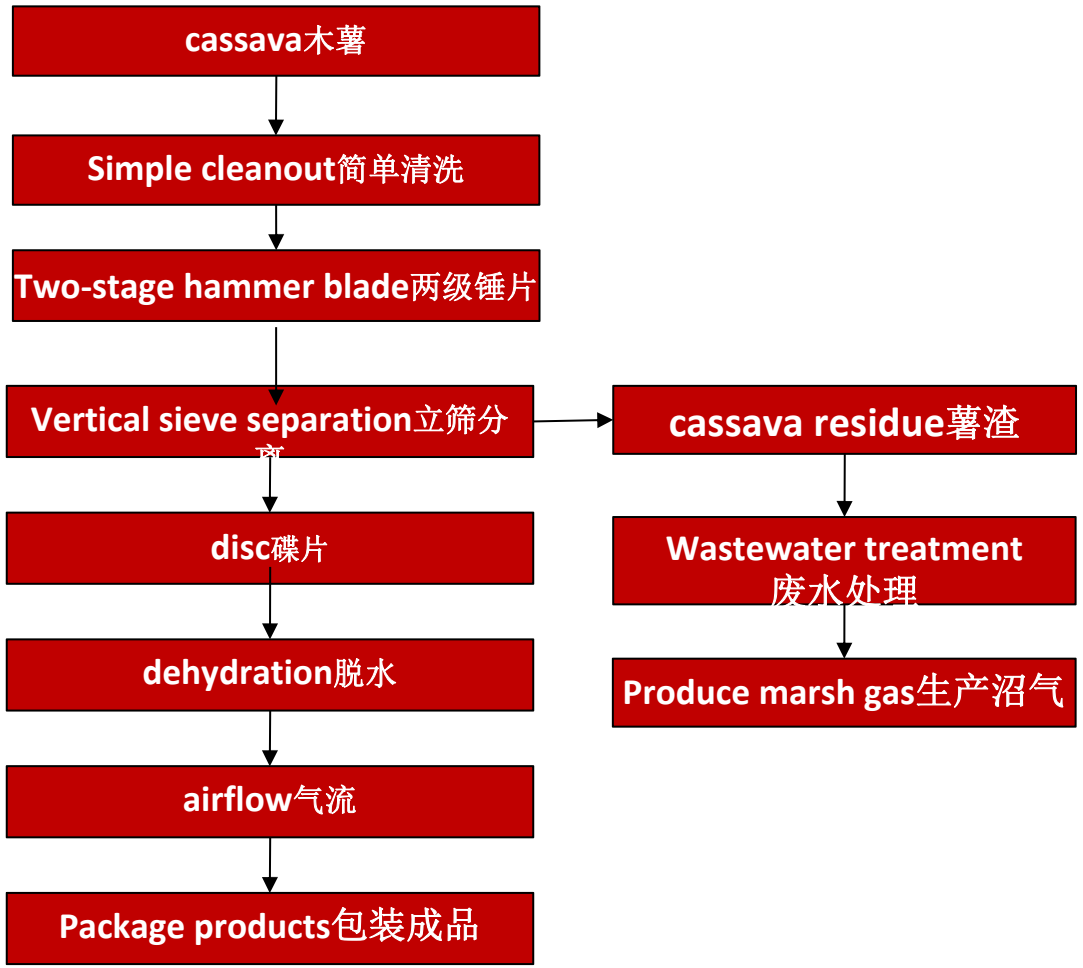
每个提取阶段都通过除砂水力旋流器，以确保完全去除沙子。安装额外的过滤器，例如旋转刷过滤器，以确保防止淀粉块通过。重复提取来自粗提取器的纸浆，以使湿纸浆中捕获的淀粉损失最小（水分含量为60-70%，干基，含淀粉含量为45-55%）。从原料中收集的淀粉浆提取浓度为20-35%（波美10-17°）。使用旋流器将淀粉浆液进一步浓缩至40%（20°波美）。

Processing of tapioca:木薯淀粉的加工
dehydration, drying——脱水、干燥

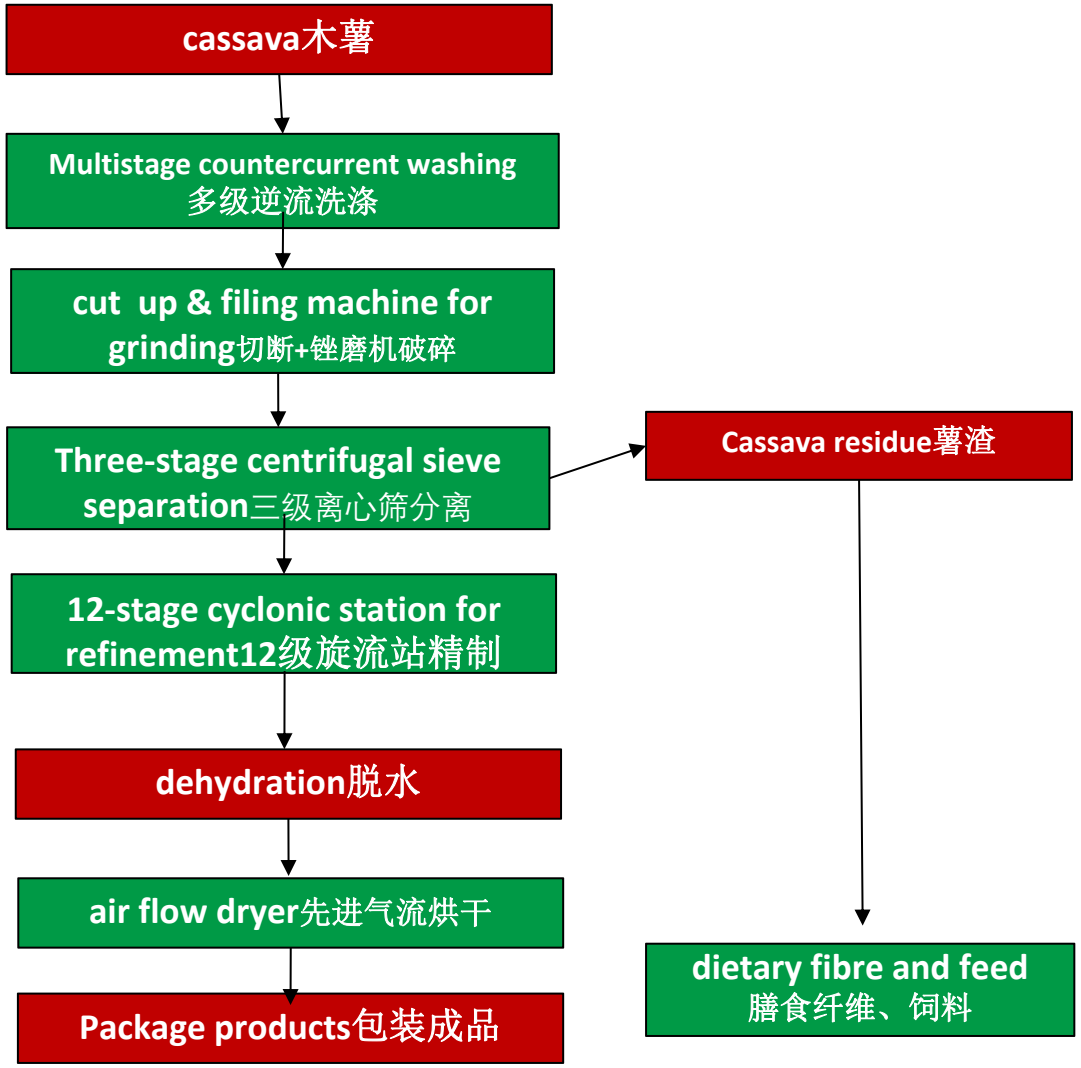
To produce raw cassava starch, the concentrated starch slurry is dehydrated in a horizontal centrifuge to produce a starch cake with a moisture content of 35-40%. The high moisture starch cake is then placed in a pneumatic conveying dryer to reduce the moisture content to less than 13% before packaging. The starch dust lost through the two hydrocyclones can be recovered by a venturi scrubber or filter bag.

为了生产木薯原淀粉，将浓缩的淀粉浆液在卧式离心机中脱水以产生水分含量为35-40%的淀粉饼。然后将高湿度淀粉饼置于干燥器的气动输送干燥器中，以在包装之前将水分含量降低至<13%。通过两个旋风分离器丢失的淀粉粉尘可以通过用文丘里洗涤器或过滤袋捕获来回收。

Improvement of cassava starch production process in China
中国木薯淀粉生产工艺改进



Flow chart of traditional production process
传统生产工艺流程图



Flow chart of new production process
新工艺生产工艺流程图

The quality of tapioca木薯淀粉的质量

Sulfur dioxide is usually used in the centrifugation or extraction stages of the cassava starch separation process to increase extraction efficiency and improve product whiteness. However, sulfur dioxide residues in the generated product can change the properties of tapioca by reducing the paste viscosity and increasing the gelatinization temperature. The control level of sulfur dioxide content represents the quality of the product, for example, SO_2 less than 30 ppm is a good product, and when the SO_2 content is zero we can call this product as Organic Tapioca Starch™.

6.2.1 食用木薯淀粉

应符合表 2 的规定。

表 2 食用木薯淀粉理化指标

项目		指标		
		优级	一级	合格
水分/(g/100 g)	≤	13.5	14.0	15.0
灰分(干基)/(g/100 g)	≤	0.20	0.30	0.40
斑点/(个/cm²)	≤	3.0	6.0	8.0
细度[150 μm(100 目)筛通过率]/%	≥	99.8	99.5	99.0
粘度[6%(干物质计),700 cmg,峰值粘度]/BU	≥	600		
白度(457 nm 蓝光反射率)/%	≥	92.0	89.0	86.0
蛋白质(干基)/(g/100 g)	≤	0.20	0.30	0.40
pH		5.0～8.0		

2

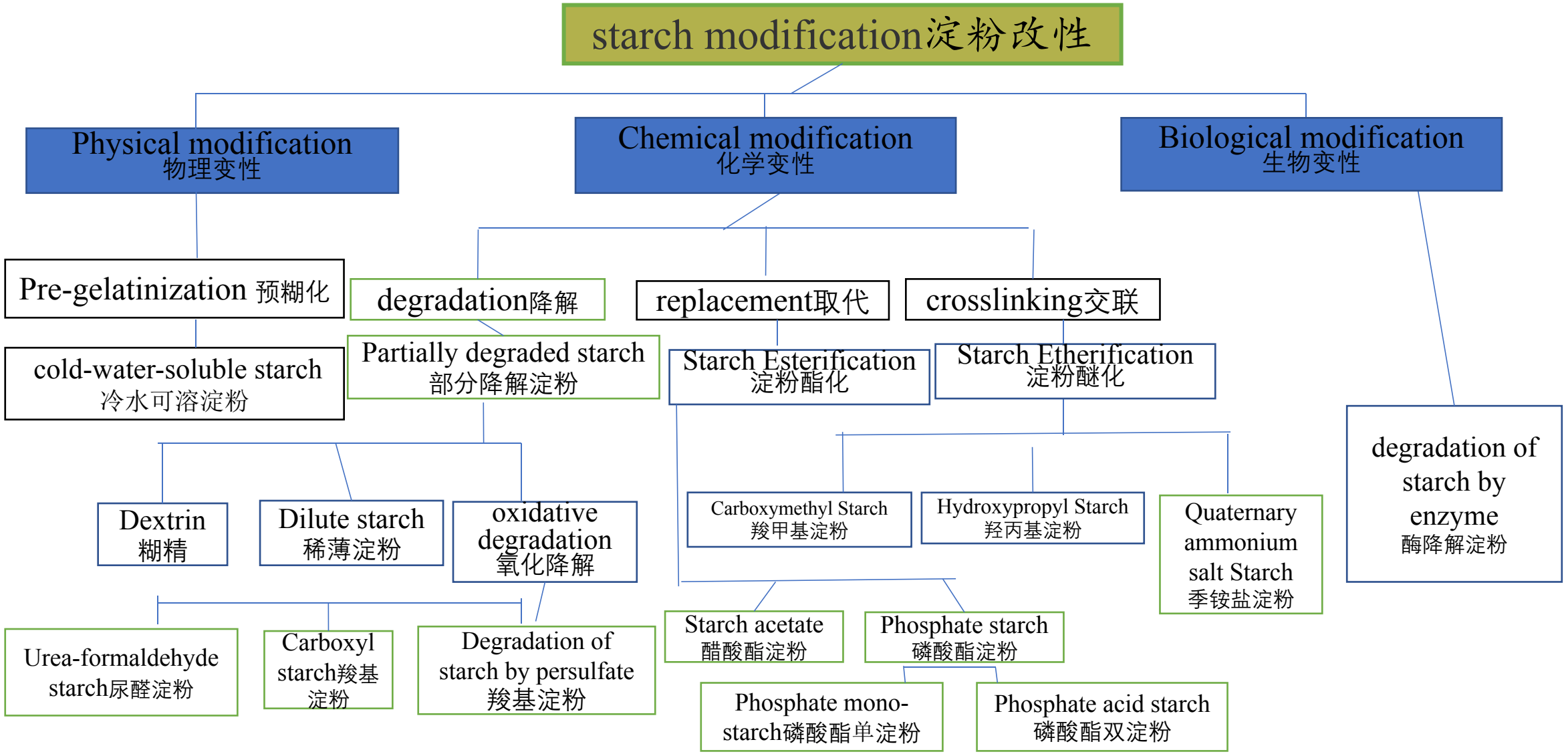
加入二氧化硫，通常用于离心或提取阶段的木薯淀粉分离过程，以提高提取效率并改善产品白度。然而，成品中的二氧化硫残留物可以通过降低糊剂粘度和提高糊化温度来改变木薯淀粉性质，二氧化硫的含量控制水平代表了产品的质量，例如SO_2小于30ppm时为优质产品，当SO_2含量为零时我们可以将此种产品称为有机木薯淀粉

02

Modification Treatment

变性处理

Modification of Tapioca 木薯淀粉的变性处理



Physical modification of tapioca物理变性处理

The methods of physical modification of tapioca
木薯淀粉的物理变性方式

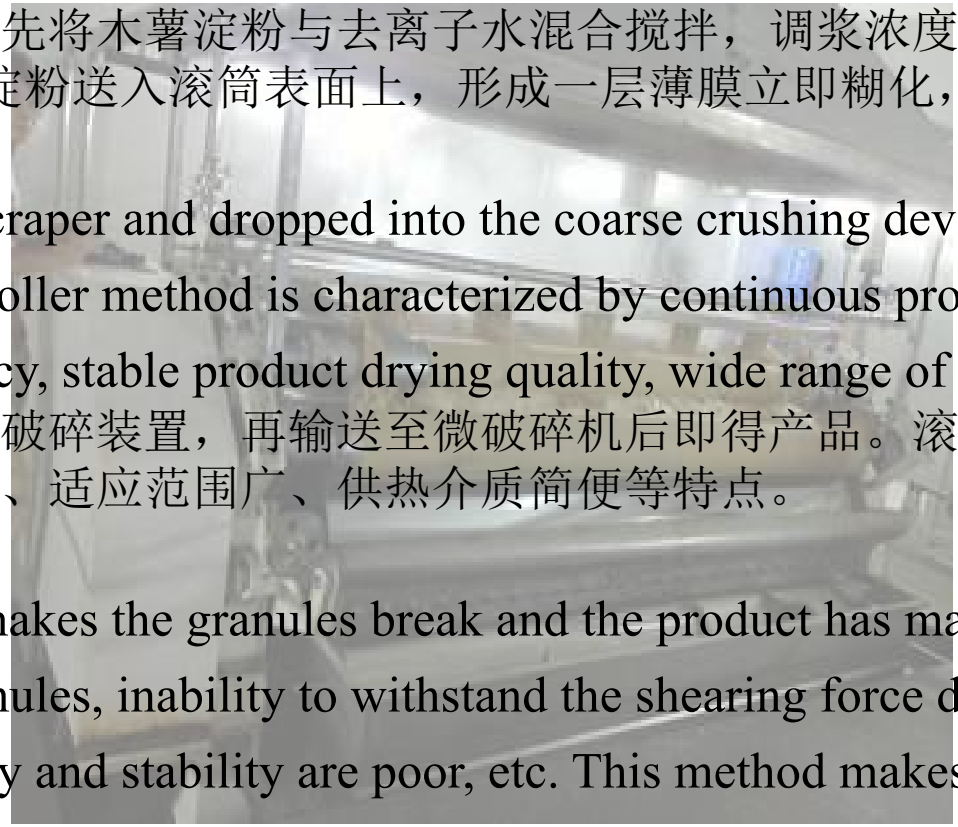
- roller pregelatinization 滚筒预糊化
- extruded expansion 挤压膨化处理
- spray drying 喷雾干燥

The methods of physical modification of tapioca: roller pregelatinization 滚筒预糊化

The process of cassava roller pre-gelatinization is as follow:

Firstly, mix the cassava starch with de-ionized water and stir it, the slurry concentration is about 40%, and the temperature is maintained at 30-40° C. The roller is heated by steam to about 160℃, and the starch is sent to the surface of the roller with a pump to form a film for immediate gelatinization and rapid dehydration and drying (moisture is about 5%).

木薯滚筒预糊化其工艺过程为，首先将木薯淀粉与去离子水混合搅拌，调浆浓度约40%，保持温度为30-40℃。滚筒内通蒸汽加热至大约160℃，用泵将淀粉送入滚筒表面上，形成一层薄膜立即糊化，并快速脱水干燥（水分约为5%）



The dried film is taken off by the scraper and dropped into the coarse crushing device, and then transported to the micro crusher to obtain the product. The roller method is characterized by continuous production, easy operation, low energy consumption, high thermal efficiency, stable product drying quality, wide range of adaptation and simple heating medium.

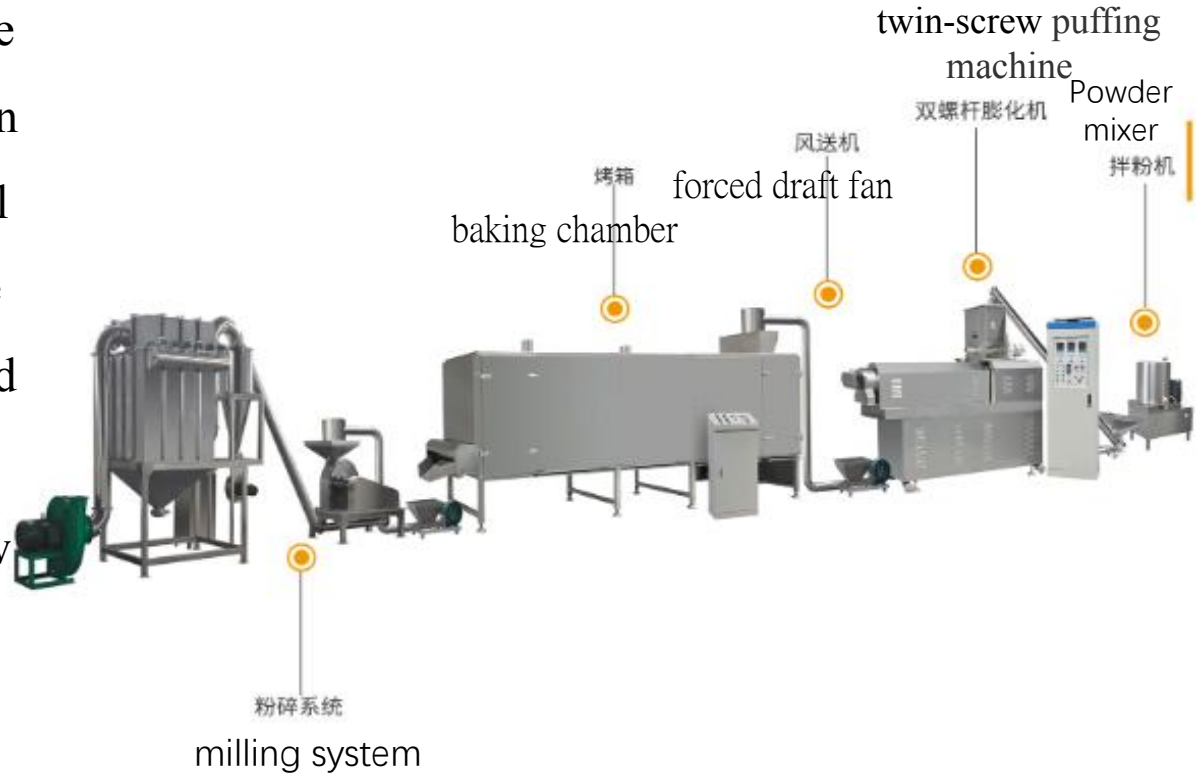
已干燥好的薄膜经刮刀取下落入粗破碎装置，再输送至微破碎机后即得产品。滚筒法具有生产连续、操作简便、能耗低、热效率高、产品干燥质量稳定、适应范围广、供热介质简便等特点。

However, this processing method makes the granules break and the product has major defects, including narrow peak viscosity range, non-integrated granules, inability to withstand the shearing force during the use and the effects of acid and alkali. The elasticity, flowability and stability are poor, etc. This method makes the starch paste only have about 80% gelatinization.

但此种加工方法使得颗粒破裂，产品有很大的缺陷，包括窄的峰值黏度范围，非完整性颗粒，不能承受使用过程中的煎切力及酸和碱的影响。弹性、流动性和稳定性较差等，这种方法使淀粉糊液只有80%左右糊化。

The methods of physical modification of tapioca—extruded expansion挤压膨化

Extrusion method is to blend the tapioca into the emulsion with water content of about 20% that is then added into the cavity of the extruder. The emulsion will be gelatinized by the high temperature between 120-160 ℃ produced by the spiral extrusion friction. Then it is extruded at high pressure through small pores of one to several millimeters in diameter, and after that, it immediately expands due to the rapid decrease in pressure, causing the water to evaporate and dry, and it is finally milled and sieved to obtain the product. This process has the characteristics of low investment in equipment, low power consumption and low production cost. However, the produced pre-gelatinized starch has low viscosity and almost no elasticity due to the high-intensity shearing force.



挤压法是将木薯淀粉调成含水量约为20%的乳液，再将乳液加入挤压机腔内，经螺旋挤压磨擦产生120-160℃的高温而糊化，然后通过孔径为一至几毫米的小孔高压挤出，由于压力急速降低立即膨胀，使水分蒸发而干燥，最后碾磨筛分即得产品。此工艺具有设备投资少、动力消耗小、生产成本低的特点。但生产的预糊化淀粉由于受高强度剪切力作用，黏度低，几乎没有弹性。

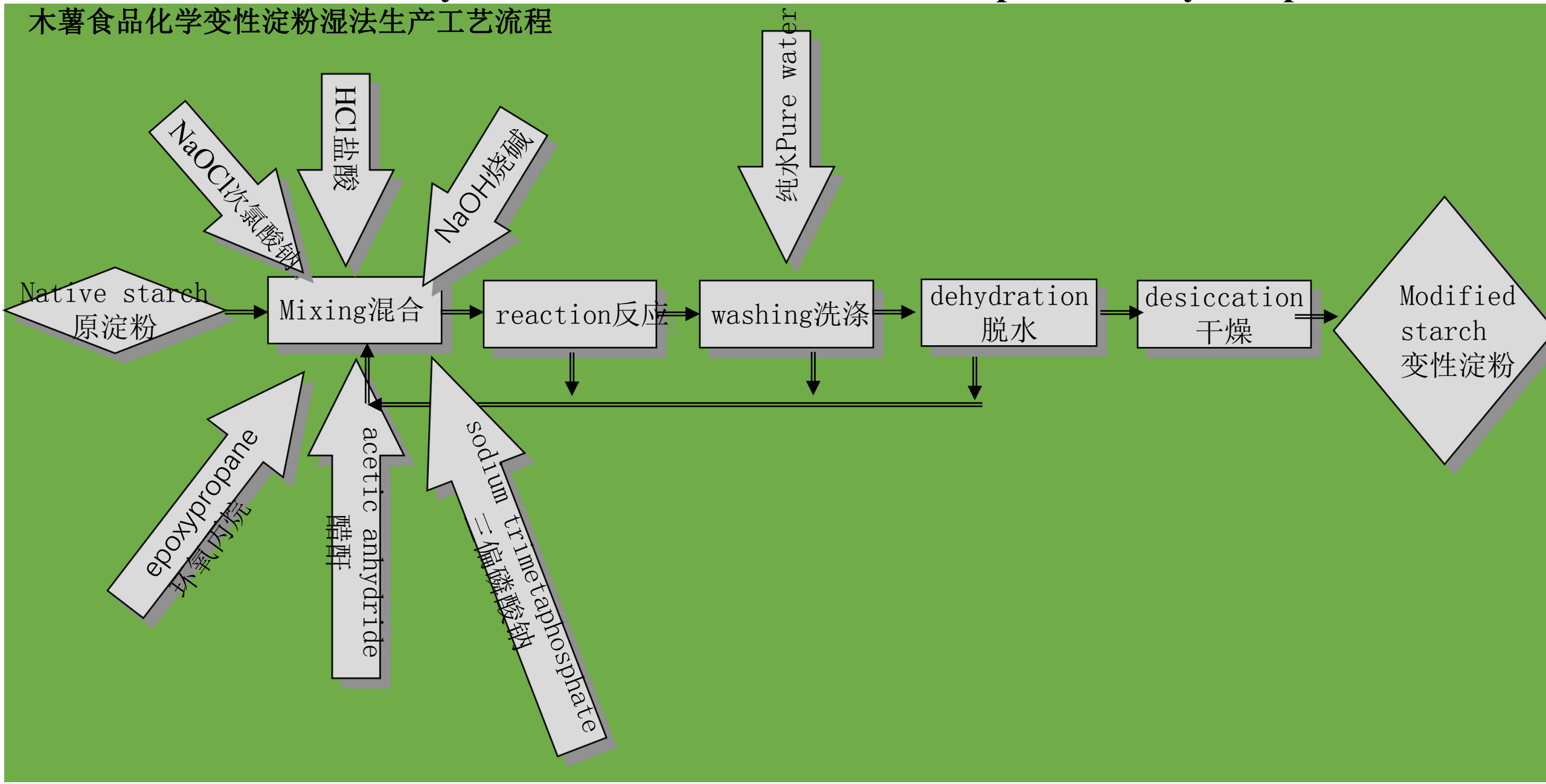
The methods of physical modification of tapioca—spray drying喷雾干燥

Spraying method to produce pre-gelatinized starch is to pre-cook tapioca emulsion into hot paste, and then according to the spray drying principl, spray the paste with a concentration of 5-8% into the drying tower for atomization and drying with high temperature airflow. Atomization is accomplished by high-pressure single-fluid nozzles and two-fluid nozzles. The atomization media are compressed air and steam. The atomization method is characterized by a hollow spherical granular product without a separate comminution process. Since the viscosity of starch emulsion increases dramatically after pasting, it makes the spraying process complicated and difficult. In addition, due to the use of low concentration of starch emulsion, the amount of water needed to be removed during drying is large, coupled with the high temperature of the exhaust air, resulting in high energy consumption, low thermal efficiency and high production costs.

喷雾法生产预糊化淀粉是木薯淀粉乳预先经蒸煮为热糊液，然后利用喷雾干燥原理，用高温气流将浓度为5-8%的糊液喷入干燥塔内雾化干燥。雾化由高压单流体喷嘴和双流体喷嘴完成。雾化媒介为压缩空气和蒸汽。喷雾法的特点是无需单独的粉碎过程即得到呈空心球状的颗粒成品。由于淀粉乳经糊化后，黏度剧增，使喷雾过程显得复杂和困难。另外，由于所使用的淀粉乳浓度低，因而干燥时需除去的水分多，加上排气的温度高，造成能耗大，热效率低，生产成本高。

Process flow of chemically modified starch in cassava food produced by wet-process

木薯食品化学变性淀粉湿法生产工艺流程



Characteristics of modified starch in cassava food 木薯食品变性淀粉的特点

Properties of chemically modified starch化学变性淀粉的性质

- **acetate starch**醋酸酯化淀粉

main characteristics：Low pasting temperature; high viscosity; good transparency; can form tough film 糊化温度低；粘度高；透明度好；可形成韧性膜

- **cross-linked starch**交联淀粉

main characteristics：Good stability against mechanical processing (high temperature, strong acid, shearing force), Short and fine threads of starch paste; good freeze thawing stability
耐机械加工（高温；强酸；剪切力）稳定性好； 糊丝短而细腻；冻融稳定性好

- **sodium hypochlorite oxidized starch**次氯酸钠氧化淀粉

main characteristics：Low viscosity; good fluidity; high transparency； can form brittle film; has some gelation
粘度低；流动性好；透明度高；可形成脆性膜；具有一定的凝胶性

- **Acid hydrolyzed starch**酸水解淀粉

Reaction conditions: Concentrated acid acts on starch at a certain temperature, causing its large molecular chains to be cut off and become small molecular chains. 一定温度下浓酸作用于淀粉，使其大分子链被切断成为小分子链。

1. **Main characteristics:** low viscosity; good fluidity; certain gelatinous properties 粘度低；流动性好；具有一定的凝胶性
2. **Difference with sodium hypochlorite oxidized starch与次氯酸钠氧化淀粉的区别:**

Reaction mechanism: as molecular chain is cut off, hydroxyl group is not oxidized to carboxyl group or aldehyde group
反应机理：分子链被切断，羟基未被氧化为羧基或醛基

Paste characteristics: slightly lower transparency and whiteness, but better gelability
糊特性：透明度及白度略低，但凝胶性较好

Characteristics of modified starch in cassava food 木薯食品变性淀粉的特点

—**phosphate ester starch** 磷酸酯淀粉

Reaction conditions: dry process, high reaction temperature (120-160℃) 反应条件：干法工艺，反应温度较高（120-160℃）

Main characteristics主要特性:

Low pasting temperature, swelling in cold water when it is of higher substitution degree; with certain emulsification; better water-holding capacity 糊化温度低，较高取代度时冷水中溶胀；具有一定的乳化性；较好的持水性

—**hydroxypropyl starch** 羟丙基淀粉

Reaction conditions: Starch is obtained by reacting with propylene oxide under strong alkaline conditions.

反应条件：淀粉与环氧丙烷在强碱性条件下反应获得

Main characteristics主要特性:

High transparency; good fluidity; stable paste with certain suspension property透明度高；流动性好；糊液稳定且具有一定的悬浮性

—**composite modified starch**复合变性淀粉

Description: a product obtained by two or more modification methods, thus having the properties of two single products.

有关说明：两种以上的变性方式获得的产品，因此兼具两种单一产品的性能。

Main categories: Crosslinked esterification; crosslinked etherification; pregelatinized compound modification, etc.

主要类别：交联酯化；交联醚化；预糊化复合变性等

Characteristics of pre-gelatinized starch: Cold water soluble, easy to use 预糊化淀粉的性质：冷水可溶使用方便快捷

Modification of industrial tapioca 工业木薯淀粉的变性处理

Cassava cationic starch for industrial use, belonging to the quaternary ammonium cationic starch, is now widely used in the paper-making industry and is one of the important chemicals for paper-making. It also has a wide range of uses in many industries such as sewage treatment, detergents and cosmetics.

工业用木薯阳离子淀粉的主要品种是季铵型阳离子淀粉，目前广泛用于造纸工业，是重要的造纸化学品之一。同时在污水处理、洗涤剂、化妆品等诸多行业中也有着广泛的用途。

In addition to this, dextrin products (including white dextrin, yellow dextrin, British gum, etc.) using hydrochloric acid as a treating agent are widely used in the field of adhesives.

除此以外以盐酸作为处理剂的糊精产品（包括白糊精、黄糊精、英国胶等）广泛的用在胶黏剂领域。

Modification of industrial tapioca—wet-process production
工业木薯淀粉的变性处理—湿法生产

The advantages of the wet process are that its requirement is not as strict as the dry process in terms of reactor structure. It uses water as medium, with low reaction temperature, easy and safe operation, easy synthesis of homogeneous cationic starch, less impurities and stable product quality. At the same time, the wet process is widely applicable, and the industrial production of other series of modified starches (such as oxidized starch, cross-linked starch, acetate starch, etc.) can be realized in the same production line without any change in production equipment.

湿法的优点对反应器结构不象干法那么要求严格，以水为介质，反应温度低，操作简便、安全，容易合成出均质阳离子淀粉，杂质少，产品质量稳定。同时，湿法工艺流程适用性广泛，在同一条生产线上，生产设备不作更改，可实现其他系列变性淀粉（如氧化淀粉、交联淀粉、淀粉醋酸酯等）的工业生产。

Modification of industrial tapioca—dry-process production
工业木薯淀粉的变性处理—干法生产

Dry-process production, where starch is reacted with chemical reagents to produce modified starch with a small amount of water (usually 20%) or a small amount of organic solvent . The advantages are the simplicity of the process, the high yield and the absence of pollution. The disadvantage is that the reaction is not homogeneous and the grafting effect of the starches is not satisfactory.

干法生产，即淀粉在含少量水（通常在20%)或少量有机溶剂的情况下与化学试剂发生反应生成变性淀粉。优点是工艺简单、收率高、无污染。缺点是反应不均匀，接枝效果不理想。

03

Food application

食　品　应　用

Application of modified starch in cassava food 木薯食品变性淀粉的应用

the application of modified tapioca in food 木薯变性淀粉在食品中的应用

- **Function of modified starch in food** 变性淀粉在食品中的功能

Food additives: thickeners; binders; stabilizers; texture and taste improvers

食品添加剂：增稠剂；粘结剂；稳定剂；改善质构及口感改良剂

Food processing aids: sprinkling powder; forming starch

食品加工助剂：撒粉；成型淀粉

- **Application of modified starch in food** 变性淀粉在食品中的应用

Instant noodles: cassava acetate esterified starch; (usage amount 8-10%) 方便面：木薯醋酸酯化淀粉（使用量8-10%）

Meat processing (ham sausage, lunch meat): acetylated di-starch phosphate, di-starch phosphate, acetylated di-starch adipate, etc.) 肉类加工（火腿肠 午餐肉）：乙酰化二淀粉磷酸酯、磷酸酯二淀粉、乙酰化二淀粉己二酸酯等）

Frozen food (frozen dumplings, frozen fish balls): acetylated di-starch phosphate and other products

速冻食品（速冻水饺 速冻鱼丸）：乙酰化二淀粉磷酸酯等产品

Condiments (oyster sauce): cross-linked esterified starch; cross-linked etherfied starch (hydroxypropyl di-starch phosphate, acetylated di-starch adipate, etc.) 调味品(蚝油)：交联酯化淀粉；交联醚化淀粉（羟丙基二淀粉磷酸酯、乙酰化二淀粉己二酸酯等）

Dairy products (ice cream, yogurt): pre-gelatinized hydroxypropyl di-starch phosphate, pre-gelatinized acetylated di-starch phosphate, etc. 乳制品（冰淇淋 酸奶）： 预糊化羟丙基二淀粉磷酸酯、预糊化乙酰化二淀粉磷酸酯等产品

Puffed food: native starch; cross-linked starch 膨化食品：原淀粉；交联淀粉

Paste and powder coating: oxidized starch; pregelatinized starch裹浆裹粉：氧化淀粉；预糊化淀粉

Application of Modified Starch in Food -- Meat
木薯食品变性淀粉的应用——肉制品应用

Application of Modified Starch in Food – Cassava Balls
木薯食品变性淀粉的应用——奶茶粉圆

Application of Modified Starch in Food – Ice Cream
木薯食品变性淀粉的应用——冰淇淋

Application of Modified Starch in Food – Starch Coating
木薯食品变性淀粉的应用——裹粉应用

Application of Modified Starch in Food – Oyster Sauce
木薯食品变性淀粉的应用——蚝油应用

From instant noodles and beef ball to prepared food like fried chicken, cassava food is becoming more and more diversified.

速冻米面到鱼丸、牛肉丸等火锅食品，炸鸡、小酥肉、中式菜肴等预制菜品，产品品类呈现多元化、复杂化发展趋势。

04

Industrial application

工　业　应　用

Application of modified tapioca in paper-making industry
木薯变性淀粉在造纸工业中的应用

Starch used in the paper industry 造纸工业使用的淀粉	The methods of modification 变性方式	use ratio 使用比例	application 应用
Wet-part starch 湿部淀粉	Cation(Amphoteric) 阳离子(两性)	21%	Filtering aid, internal sizing, retention aid, dry strength improvement 助滤，内施胶，助留，提高干强
Surface starch 表面淀粉	Enzymatic starch, Oxidized starch 酶解淀粉，氧化淀粉	64%	Improve printability, smoothness, Z direction strength, tear length, breakage resistance and stiffness 改善印刷性，改善平滑度, 提高 Z- 强度，提高撕裂长度，耐破度，提高挺度
coating starch 涂布淀粉	Oxidized starch, dextrin; Enzymatic treatment, esterified starch 氧化淀粉，糊精；酶处理、酯化淀粉	12%	Adhesives, Improve printability and water retention 粘合剂，改善印刷性，提高保水
spraying starch 喷淋淀粉	Native starch; Cross-linked starch 原淀粉；交联淀粉	3%	improve the interlaminar strength 提高层间强度

Application of modified tapioca in paper-making industry
木薯变性淀粉在造纸工业中的应用

dry strength agent 干燥剂	Enhance inter-fiber hydrogen bonding提高纤维间氢键的结合
retention aid 助留剂	Improve the retention of filler because of the positive charge property of starch 提高填料的保留率因为淀粉的阳电荷特性
sizing 施胶	Protect ASA sizing and emulsify it 保护ASA施胶，并对其进行乳化
drainage助滤	Improve water filtration effect while passing through the press section of the paper machine提高滤水效果在经过纸机的压榨部时

Application of modified tapioca in agglomerant industry
木薯变性淀粉在粘结剂工业中的应用

Paper bags bonding by starch
纸袋胶粘用淀粉

Raw material: cassava

1、Cross-linked and cold water soluble
进行交联处理并且冷水可溶

2、dissolving tank is needed during the production process of agglomerant
胶水在生产过程中需要溶解桶

3、Starch concentration between approx. 17 and 40% 淀粉的浓度约为17~40%之间
(For the horizontal, vertical and bottom bonding of paper bags)
用于纸袋的横向、纵向及底部粘合

Application of modified tapioca in agglomerant industry
木薯变性淀粉在粘结剂工业中的应用

starch agglomerant requires the following characteristics 粘合剂淀粉需要特性:

High viscosity 高粘性

Low throw-off properties 低甩料性

Excellent viscosity stability 优异的粘度稳定性

Excellent operational stability 优异的运行稳定性

Application of modified tapioca in textile industry
木薯变性淀粉在纺织工业中的应用

Sizing: Sizing the warp is the key to reducing its breakage and protecting it from weaving on the machine. 上浆：经纱上浆是减少经纱断裂，保护经纱在机器上织造的关键

Starch is mainly used in textile treatment and is removed after processing.
淀粉主要用于纺织处理，加工后去除。

Degradable modified starch ether/ester products made from cassava .

Modified products: hydroxypropyl, carboxymethyl, acetyl, carbamate.

适用的淀粉基于木薯的降解改性淀粉醚/酯产品作为首选的产品。
也可以是以下改性产品：羟丙基，羧甲基，乙酰基，氨基甲酸酯。

木薯变性淀粉在禽畜养殖中的应用

Application of modified tapioca in livestock breeding

饲料用淀粉

原料：木薯
通过预糊化处理并且冷水可溶
在饲料造粒中作为粘合剂使用

Starch for feed

raw material : cassava
cassava is pre-gelatinized and soluble in cold water for use as a binder in feed granulation

木薯变性淀粉在制药中的应用
Application of modified tapioca in pharmacy

明胶空心胶囊

包括明胶空心胶囊、肠溶明胶空心胶囊。是目前最常见的空心胶囊。

植物空心胶囊

包括羟丙基淀粉空心胶囊、羟丙基甲基纤维素空心胶囊、普鲁兰多糖空心胶囊等

Gelatine empty capsules

Include gelatine empty capsules and enteric gelatine empty capsules, which are by far the most common type of empty capsules.

Vegetable empty capsules

Including hydroxypropyl starch empty capsules, hydroxypropyl methylcellulose empty capsules, prululan polysaccharide empty capsules, etc.

环保建材

green building materials

防霉超白

mould proof & super white

喷刷均可

Can be sprayed or brushed

木薯淀粉中国市场前景广阔，与木薯相关上下游产业需求旺盛
The Chinese market for cassava starch is promising, with strong demand from cassava-related upstream and downstream industries

1、中国木薯淀粉市场在食品、造纸、饲料、制药、建材、胶黏剂等产业需求旺盛
2、木薯变性淀粉可应用于中国的多个行业，中国也有木薯改性淀粉的加工能力，对木薯淀粉需求旺盛
3、非洲盛产木薯，作为中国木薯淀粉的主要供应商

1. Tapioca is widely demanded in food, paper-making, feed, pharmacy, building, adhesives and other industries in China
2. Modified tapioca can be used in many industries in China, and China also has the processing capacity of it , so tapioca is widely used.
3. Africa is rich in cassava, as the main supplier of tapioca in China

Thank you !