Research Progress on Composition Changes, Pharmacological Effects and Food Processing Applications of Luo Han Guo Under the Control of Different Drying Technologies

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Abstract This paper summarizes the influence of different drying technologies on the appearance, taste, and chemical composition of Luo Han Guo. Building on its traditional efficacy of moistening the lungs and relieving cough as a starting point, and delves into the in-depth mechanism of its anti-inflammatory activity. Besides, it explores its antioxidant and hypoglycemic pharmacological properties, revealing the intrinsic correlation between its traditional efficacy and modern bioactivities. Modern drying technologies have enhanced the extraction efficiency of sweet-tasting and functional components in Luo Han Guo, expanding its development and application in modern food products. At present, there is a lack of studies on the differences in the efficacy of Luo Han Guo processed using various drying technology, and a significant gap exists in the research and development of its food-related applications. Therefore, this paper synthesizes the relevant research findings to provide a reference for the innovation of Luo Han Guo processing technologies and its future modern research and applications.

Key words Luo Han Guo (*Siraitia grosvenorii* (Swingle) C. Jeffrey), Drying technologies, Active components, Pharmacological action, Food processing applications, Food and medicine homology

1 Introduction

Luo Han Guo, also known as *Siraitia grosvenorii* (Swingle) C. Jeffrey, was recorded in the records of Guilin Prefecture in the 24th year of Wanli in the Ming Dynasty: "Luo Han Guo, which came from Yongfu and Lingui mountains, is as big as an orange, tastes extremely sweet, and is boiled to quench thirst". The Lingnan medicine collection record at the end of the Qing Dynasty and the beginning of the Republic of China recorded its usage and efficacy: "A single taste of tea can detoxify soot". It is one of the first batches of Chinese medicinal materials with the same origin as food and medicine in China. It is a traditional medicinal material in Guangxi and has a long planting history in Yongfu County, Guilin City, Guangxi[1-2].

Based on the advancements in modern science and technology, the development of Luo Han Guo drying technologies has optimized its appearance, flavor, and retention of active components, thereby extending its diverse pharmacological effects. Beyond its medicinal applications, its core active ingredient, mogrosides, has the characteristics of high sweetness, zero calories, no cariogenic, and does not affect blood glucose levels. These properties make them high-quality natural additives for the development of sugar-free foods, functional beverages, and special dietary products for individuals with diabetes[3-5]. In this review, the effects of different drying technologies on the properties, flavor, and active components of Luo Han Guo were discussed, and the pharmacological influence of related components and extracts and food application literatures were systematically summarized to further deepen the development of the use of this Chinese medicine with the same origin as medicine and food.

2 Main drying technologies

Fresh Luo Han Guo is characterized by high moisture content, abundant nutrients, and a unique flavor. However, it exhibits relatively weak sweetness, insufficient taste intensity, and short shelf life. Upon prolonged storage, the fruit softens, is highly susceptible to mold growth, and is prone to crushing and damage during transportation and storagefactors that adversely affect its appearance quality[6]. Low temperature storage can prolong the storage time, but it is prone to cold injury symptoms, such as skin depression and browning[7-8]. According to the agricultural harvesting standards and eating habits of Luo Han Guo, and the characteristics that the fruit is usually used as a whole fruit for medicine, the *Pharmacopoeia of the People's Republic of China* (Volume I, 2025 Edition) stipulates that it should be harvested when the fruit is dark green, dried, and used as a complete fruit for medicine. Drying treatment can better preserve the color and shape of Luo Han Guo, preserve the taste, extend the shelf life and retain the medicinal components[9-10].

2.1 Transformation from traditional to modern drying technology Traditional drying technologies of Luo Han Guo include sun drying (SD) and hot air drying (HAD), which have a long history of application and are usually based on natural conditions

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or simple thermal processing[11]. The core advantage of these drying technologies is that they are the most commonly used drying technology with no additives and low costs. SD is vulnerable to the impact of local climate change, and has problems such as appearance damage and quality deterioration[12]. HAD is carried out through hot air convection, which has high efficiency and controllable cost, but there may be problems of high-quality loss and energy consumption, it is easy to make some fruits to darken locally, and the rehydration effect is poor[13]. Due to the defects of the traditional drying technology, modern industry has improved it and developed three methods: microwave drying (MD), microwave vacuum drying (MVD) and freeze drying (FD). MD uses electromagnetic wave heating and has a fast drying speed, but it has the same problem of local overheating as the HAD[14]. MVD was further improved based on MD. It reduces the boiling point using a microwave electromagnetic field combined with a vacuum environment to achieve low-temperature and rapid drying. Simultaneously, microwave heating evenly avoids local overheating and retains the original color and flavor of the materials. However, process control is complex and suitable for the production of heat-sensitive materials[15]. FD removes moisture through low-temperature sublimation, which has strong long-term stability and wide applicability, but it has high energy consumption and cost and strict requirements, so it needs to be equipped with a special air conditioning dehumidification system[16]. The nutritional components of Luo Han Guo processed by the two drying technology are relatively completely retained, and the taste is sweeter and richer, with a hard texture that is not easy to damage, which greatly improves the quality of Luo Han Guo dried fruit. Currently, the primary drying technology in Yongfu County, Guilin, Guangxi Zhuang Autonomous Region, where genuine medicinal materials are produced, is freeze drying, the freeze dried Luo Han Guokeeps the color and shape basically unchanged, with little change in the original pharmacological components and good rehydration effect[17].

2.2 Influence of different drying technologies on the appearance and taste The appearance and taste of Luo Han Guo are the core features of its quality and safety, and different drying technologies directly affect its final taste experience and medicinal performance (Table 1). According to the relevant research, MVD and FD have a better drying effect and can better maintain the fruit quality[18-22].

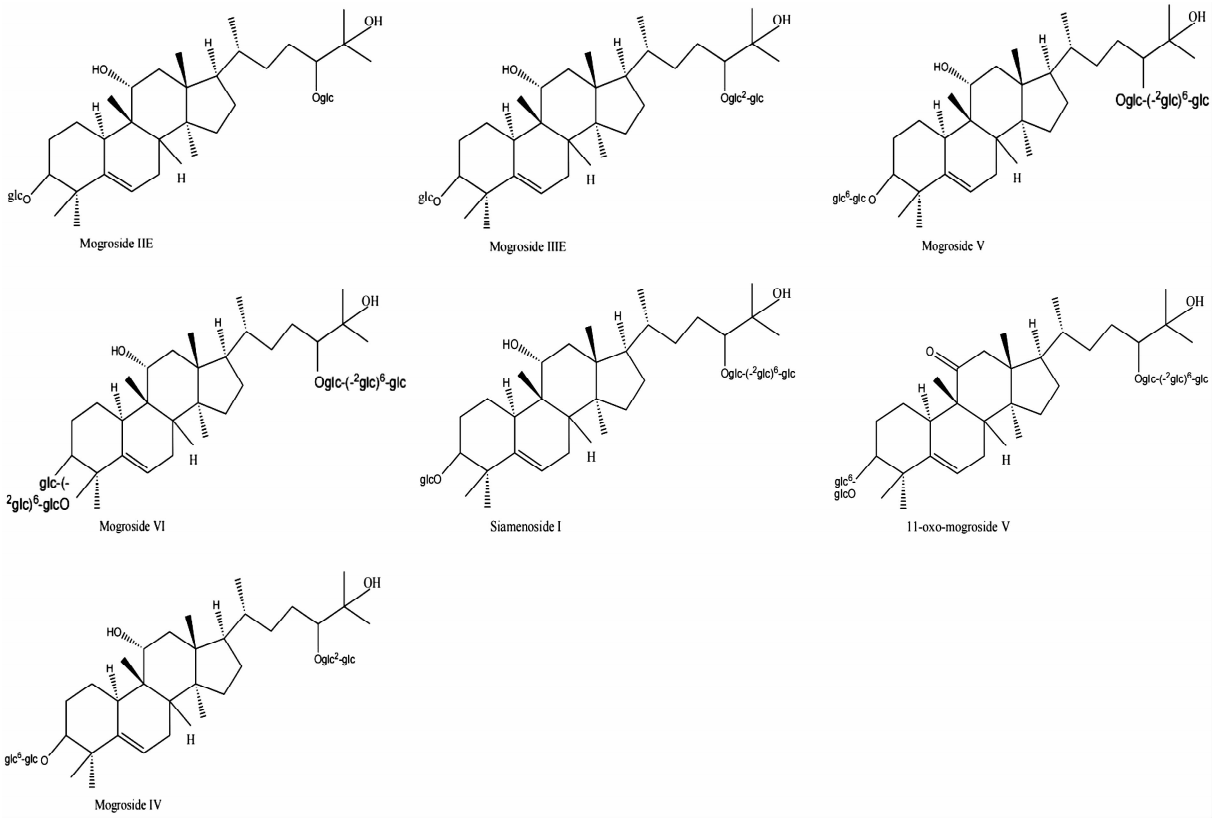
Table 1 Comparison of appearance and taste of Luo Han Guo with different drying technologies

Drying technology	Appearance changes	Fruit shape integrity	Moisture %	Taste	Main disadvantages	Reference
HAD	The drying effect is poor, the outside is dry and the inside is wet with a sticky feeling, and the fruit flavor is not obvious	Complete and easy to shrink	<15	Bitterness and astringency increase, while freshness decreases	It is easy to be affected by the local climate, and the fruit quality varies greatly after drying.	[18-22]
MD	The drying effect is good, but there is a slight medicinal smell and local burning phenomenon	Complete and easy to shrink	<15	Increased sweetness, bitterness and bitter aftertaste	Uneven heating, serious external wet and internal dry phenomenon, obvious burnt taste and poor rehydration.	[18-22]
MVD	The drying effect is good, and the powder shows fruit flavor	Complete	<15	Fruity aroma	The equipment cost is high and the operation is difficult.	[18-22]
FD	The fruit surface is bright, can keep the original fruit color for a long time, and the pulp is full and white	Complete	<15	Increased sweetness, bitterness and bitter aftertaste	The equipment cost is high, the operation is difficult, and the requirement of environmental dependence is high.	[18-22]

2.3 Influence of drying technology on effective components According to the relevant literature, Luo Han Guo primarily contains cucurbitane triterpenoids, flavonoids, polysaccharides, and other bioactive components, with cucurbitane triterpenoids identified as the major active constituents[23]. These bioactive components are susceptible to degradation and loss under natural conditions due to the influence of temperature, humidity, transportation, and other factors, thereby impairing their medicinal efficacy[24]. Studies have demonstrated that when Luo Han Guo is dried using an appropriate process, the loss of its main active components is reduced, and its quality is ensured[25].

2.3.1 Cucurbitane triterpenoids. Different drying technologies induce variations in the bioactive components of Luo Han Guo, among which triterpenoids and flavonoids serve as major active constituents and key indicators for evaluating drying efficacy[10]. The total triterpenoid content in Luo Han Guo is approximately 3.8%, encompassing Siraitoside III, Siraitoside IV, Mogroside V, and Mogroside VI[26] (Fig. 1). The *Pharmacopoeia of the People's Republic of China* (Volume I, 2025 Edition) stipulates that the Mogroside V content in dried Luo Han Guo must be ≥ 0.50% to meet qualification standards.

Liu *et al.* [25] investigated the effects of three drying technologies (HAD, MD, and MVD) on Mogroside V content. Their results showed that MVD yielded the highest Mogroside V content (1.63%), while HAD resulted in the lowest (0.97%), with the order of content being MVD > MD > HAD. Building on Liu's work, Shen *et al.* [27] incorporated freeze drying (FD) as an additional modern drying technology, and their findings indicated the following hierarchy of Mogroside V content: FD > MVD > HAD > fresh fruit. Fang *et al.* [28] further analyzed the contents of total saponins, Mogroside V, 11-oxo-mogroside V, Saimenoside I, Mogroside IV, Mogroside IIIE, and Mogroside IIE across different drying methods. The results demonstrated that the highest contents of 11-oxo-mogroside V and Mogroside V were the highest in FD.



NOTE CAS CN: Mogroside IIE: 88901-38-6, Mogroside IIIE: 88901-37-5, Mogroside V: 88901-36-4, Mogroside VI: 89590-98-7, Saimenoside I: 126105-12-2, 11-oxo-mogroside V: 126105-11-1, Mogroside IV: 89590-95-4.

Fig. 1 Structural formula of several common Mogroside

2.3.2 Flavonoids. Flavonoids in Luo Han Guo exist primarily as aglycones, with kaempferol and quercetin identified as the major components[28-30]. Existing studies have indicated that total flavonoid content increases significantly with elevated drying temperatures. Additionally, flavonoids can be generated via the Maillard reaction of reducing sugars during drying.

Fang *et al.*[28-30] determined total flavonoid content in Luo Han Guo processed by FD and compared it with that of samples dried by other technologies HAD and MD. Their results showed the order of total flavonoid content as: HAD > FD > MD, with total flavonoid levels in HAD samples significantly higher than those in the other two groups. Shen *et al.*[27] further verified this trend by investigating total flavonoid content in Luo Han Guo dried via HAD, FD, and MVD.

2.3.3 Amino acids, protein, fat, vitamin C and volatile components. According to the existing research[24], the content of 16 common free amino acids in Luo Han Guo accounts for over 4.5% of its total composition. Among these, the combined content of AlA, ARG, ASN, GLU and LYS exceeded 70% of the total free amino acid content across all samples, with ASN and GLU identified as the major free amino acids in Luo Han Guo (Table 2). Compared to fresh fruits, Luo Han Guo processed by FD, MD, and HAD exhibited significant reductions in the contents of ARG, ASN, CYS-CYS, GLU, GLY, HIS, LYS, PRO, TYR, and the total 16 free amino acids. Notably, MET content increases in FD and MD, and GLU levels are higher, while HAD resulted in higher level of ARG content but lower level of other amino acids. Electronic tongue analysis indicated a correlation between amino acid profiles and the flavor characteristics of Luo Han Guo.

Table 2 Common free amino acids in Luo Han Guo

No.	Compound name	Abbreviation	Taste	Reference
1	Alanine	ALA	Sweet, flesh	[24]
2	Arginine	ARG	Bitterness	[24]
3	Aspartic acid	ASP	Flesh	[24]
4	Cystine	CYS-CYS	Flesh	[24]
5	Glutamic acid	GLU	Flesh	[24]
6	Glycine	GLY	Flesh	[24]
7	Histidine	HIS	Flesh	[24]
8	Leucine	LEU	Sweet	[24]
9	Isoleucine	ILE	Bitterness, astringent	[24]
10	Lysine	LYS	Bitterness	[24]
11	Methionine	MET	Sweet	[24]
12	Proline	PRO	Sweet	[24]
13	Serine	SER	Flesh	[24]
14	Threonine	THR	Sweet	[24]
15	Tryptophan	TRP	Sweet	[24]
16	Tyrosine	TYR	Flesh	[24]
17	Phenylalanine	PHE	Not detected	[24]
18	Valine	VAL	Not detected	[24]

Shen *et al.* [27] determined the contents of protein, fat, vitamin C, and volatile components in Luo Han Guo processed by different drying technologies. The findings revealed that different drying treatments exerted no significant effect on the protein content of Luo Han Guo. Notably, the fat content of fresh fruits and those processed by VD was significantly higher than that of samples dried using other technologies. Compared with fresh Luo Han Guo, HAD resulted in a lower vitamin C content but a significant increase in reducing sugar levels. In addition, the total amount of volatile components increased remarkably after drying, with these components predominantly consisting of hydrocarbons, esters, ketones, acids, alcohols, phenols, aldehydes, ethers, terpenes, and other compounds.

2.3.4 Polysaccharides. He *et al.* [31-32] investigated the polysaccharide composition of Luo Han Guo using hot air drying(HAD), vacuum drying(VD), and microwave drying(MD). The results showed that the polysaccharides in fresh and dried fruits were of the same type, namely, pectin polysaccharides. The monosaccharides were composed of mannose, rhamnose, glucuronic acid, galacturonic acid, glucose, galactose, and arabinose; however, there were differences in the proportion, molecular weight distribution, and microstructure of the monosaccharides. It can be observed that the drying process of Luo Han Guo has a significant impact on the extraction rate and the physical and chemical characteristics of its polysaccharide components.

Collectively, these studies indicate that different drying technologies induce variations in the basic components, volatile substances, and bioactive constituents of Luo Han Guo. Traditional drying methods substantially compromise the fruit's flavor and cause significant losses of nutrients and functional components. MVD and FD exhibited superior performance in preserving the bioactive components of Luo Han Guo. MVD offers the advantage of a short processing time, making it suitable for large-scale production. In contrast, FD is ideal for whole-fruit drying due to its ability to retain the fruit's natural flavor, albeit with higher technical and equipment requirements. While both technologies possess distinct merits, their overall advantages in maintaining Luo Han Guo quality are significant.

3 Pharmacological effects

The main effect of Luo Han Guo in traditional Chinese medicine theory is "moistening the lung and relieving cough", while modern pharmacological research accurately corresponds the traditional effect to specific action targets such as anti-inflammatory, antioxidanthypoglycemic and so on by analyzing the molecular mechanism of its active components, such as cucurbitane triterpenoids, flavonoids, polysaccharides and so on. In this transformation process, different drying technologies play a key role in the retention differences of active components.

3.1 Antitussive and anti-inflammatory effects In the application of traditional Chinese medicine, the "cough relieving" effect of Luo Han Guo is mostly based on "clearing heat and moistening lung", which plays a role by relieving cough symptoms caused by lung dryness[33-34], however, modern pharmacological research has precisely disassembled this traditional effect into an "anti-inflammatory" mechanism, that is, blocking the trigger pathway of cough from the pathological level by inhibiting the inflammatory response of the respiratory tract and reducing the release of inflammatory factors[35].

Fang *et al.* [28] investigated the anti-inflammatory activity of Luo Han Guo by FD, MD and HAD. The results showed that the active components of Luo Han Guo processed using different methods changed, and the anti-inflammatory activity was related to this change. The content of total saponins, 11-oxo-mogroside V and secondary glycosides was positively correlated with anti-inflammatory activity. The total flavonoid content increased significantly with increasing drying temperatures. The content of total saponins and flavonoids was significantly positively correlated with NO inhibitory activity, but the content of total sugar decreased with increasing temperature, and the content was negatively correlated with reactive oxygen species inhibitory activity. Mi *et al.* [36-37] studied the effect of the active extract of Luo Han Guo on airway inflammation in mice with chronic obstructive pulmonary disease (COPD) and Human normal lung epithelial cells (BEAS-2B), it can reduce airway inflammation, inhibit the expression and production of inflammatory cytokines, and improve the effect of expectoration by increasing the secretion of phenol red. Mogroside V can inhibit the release of inflammatory mediators, reduce the inflammatory response and neuroinflammation, and protect neurons from damage, thus showing a mitigation effect on a variety of inflammatory diseases. Liu *et al.* [38] found that Mogroside V significantly inhibited the production of pro-inflammatory factors in microglia induced by lipopolysaccharide (LPS), and could protect against LPS induced neurotoxicity. Jiang *et al.* [39] found that Mogroside V inhibited the apoptosis and cycle arrest of dopaminergic neurons caused by microglia activation, and alleviated inflammatory injury to a certain extent. This mechanism may be related to the promotion of SIRT3 expression and improvement of mitochondrial function. Wu *et al.* [40] found through research that flavone glycoside in Luo Han Guo can reduce the release of inflammatory cytokines from inflammatory macrophages and participate in regulating the anti-inflammatory effect of macrophages.

3.2 Antioxidant activity A close correlation exists between the antioxidant activity of Luo Han Guo and its traditional efficacy in "moistening the lung and relieving cough". This correlation is mainly mediated by active components such as cucurbitane triterpenes, flavonoids, and polysaccharides and their co-regulation of the inflammatory pathway of oxidative stress. These components modulate the body's antioxidant system by scavenging free radicals and inhibiting oxidative reactions[41-43]. Different drying technologies, which vary in temperature and humidity, directly impact the retention efficiency of these bioactive constituents, inducing variations in antioxidant activity. Drying technology is a core determinant of the practical value of Luo Han Guo antioxidants. Shen

et al. [27] found that the ABTS free radical scavenging capacity of Luo Han Guo by different drying technologies was HAD > FD, MVD > fresh fruits. On the whole, the antioxidant capacity of dried fruits is higher than that of fresh fruits, and the antioxidant capacity of cucurbitane glycosides polyphenols and flavonoids is stronger.

Huang *et al.* [44-45] found that the scavenging rate of Mogroside IIA on DPPH free radicals was 17.23%, and the scavenging rate of superoxide anion free radicals was 16.48%. He *et al.* [46] found that the scavenging rates of DPPH and ABTS free radicals of Mogroside V were 49.19% and 47.56%, respectively, which were 0.54 and 0.49 times that of VC, respectively. Liu *et al.* [47] found that Mogroside V has a protective effect on corticosterone-induced PC12 nerve cell injury, and can significantly reduce the oxidative stress injury and apoptosis level of hippocampal nerve cells. Zhu *et al.* [48] isolated and purified a new polysaccharide from Luo Han Guo. The results of biological activity experiments showed that polysaccharide could reduce H_2O_2 oxidative damage to PC12 cells, effectively scavenge DPPH free radicals, and exert a good antioxidant effect. Gong *et al.* [49] found that polysaccharides extracted from Luo Han Guo exhibited good hypoglycemic and antioxidant activities *in vitro*.

Bin *et al.* [50] found that two flavonoids, Kaempferol and Quercetin, from Luo Han Guo can effectively neutralize free radicals in the human body, protect cells from oxidative stress damage, and thus maintain the health and balance of the body. Wu *et al.* [40] found through research that the flavonoid glycoside in Luo Han Guo has high antioxidant potential. The antioxidant protection of flavonoid glycosides can effectively inhibit the content of intracellular antioxidant enzymes, prevent SOD depletion, and reduce intracellular ROS.

3.3 Lowering blood sugar and alleviating diabetic symptoms

According to existing research, the core of the traditional effect of Luo Han Guo on "moistening the lung and relieving cough" is that cucurbitane triterpenes and other active components participate in anti-inflammatory and antioxidant activities. With the increase in the incidence rate of diabetes in recent years, Luo Han Guo has attracted extensive attention because of its high sweetness and low calorie characteristics. Modern pharmacological research has further revealed that these active components reduce blood sugar levels. Mogroside can delay the decomposition and absorption of carbohydrates, reduce the peak blood sugar after meals, regulate the insulin signaling pathway, improve insulin resistance, and stabilize blood sugar homeostasis by inhibiting the activity of intestinal α-glucosidase[51]. Related studies have found that different drying methods have an impact on the inhibition rate of α-glucosidase of Luo Han Guo. Shen *et al.* [27] found that the inhibition rate of α-glucosidase in the extract of Luo Han Guo by HAD, MVD and FD was higher than that of fresh fruit; the inhibition rate of dry fruit was 79.65% -84.62%, and that of fresh fruit was 71.36%, from high to low: MVD > FD > HAD > fresh fruit, the overall performance is that dry fruit is higher than fresh fruit. The hypoglycemic ability of the three types of dried fruit was significantly higher than that of fresh fruit, and the content of bioactive components in dried fruit samples was higher and relatively stable. Jing *et al.* [52] determined through experiments that the IC_{50} value of Luo Han Guo extract for α-glucosidase was (12.94 ± 0.71) mg/mL, and the IC_{50} value for α-amylase was (22.34 ± 0.16) mg/mL, it has a good regulatory effect.

Mogroside can effectively reduce blood sugar levels by lowering insulin resistance. Zhang *et al.* [53] found that low-polar Mogroside can reduce insulin resistance in obese rats, and it can regulate insulin secretion in type 2 diabetic (T2MD) rats by increasing the level of GLP-1. According to relevant studies, intestinal flora can improve the symptoms of diabetes, and mogroside has the characteristics of reducing blood glucose and regulating intestinal flora. Qin *et al.* [54] found that Mogroside improved liver glucose metabolism in T2MD mice, reduced plasma endotoxin, alleviated T2MD, regulated intestinal flora and improved intestinal mucosal barrier, indicating that Mogroside is a potential therapeutic agent or intestinal microbiota regulator for the treatment of T2MD. Guo *et al.* [55] found that Luo Han Guo polysaccharides were partially degraded during *in vitro* fermentation and were degraded and utilized by human intestinal microbiota. After *in vitro* digestion and enzymatic digestion, the hypoglycemic activity of Luo Han Guo polysaccharides *in vitro* remained relatively high. Tanaka *et al.* [56] found that mogrol activated insulin secretion of pancreatic β-cells under hypoglycemic conditions. Mogrol can promote insulin secretion without affecting the quality of β-cells and insulin levels and alleviate hyperglycemia in diabetic mice. These results indicate that mogrol can stimulate insulin secretion to alleviate hyperglycemia in mice.

4 Food development and application

Luo Han Guo food was first used among the people in Guangdong and Guangxi. The *Guangxi General Annals* records that "when the natives use fire to dry, they pay for the tea, and the cloud can clear the heat and moisten the throat, and they can also use medicine". Luo Han Guo tea is the most common way of drinking among ancient people[57]. Its "tea drinking" form not only retains the efficacy of medicinal materials but also conforms to daily drinking habits, forming a tea recipe centered on "clearing the throat and throat" and "purging the bowels and lowering the fire." The evolution of Luo Han Guoi as a food product represents the deep integration of traditional food culture and modern health needs. With the breakthrough of modern food industry technology and the demand of modern people for "healthy low sugar," the application of Luo Han Guo has been extended to the field of food additives[58-61]. With the development of modern drying technology, freeze-dried *Momordica grosvenorii* has a high retention of sweet glycosides, flavonoids, and other active components. Relying on modern food processing technology, high-purity sweet glycosides are separated from Luo Han Guo through water extraction, purification, and other processes, and then they are used as "nat-

ural sweeteners" or "functional components" to be integrated into the industrial production of beverages, baking, flavored leisure food, high-quality feed, and other products (Fig. 2).

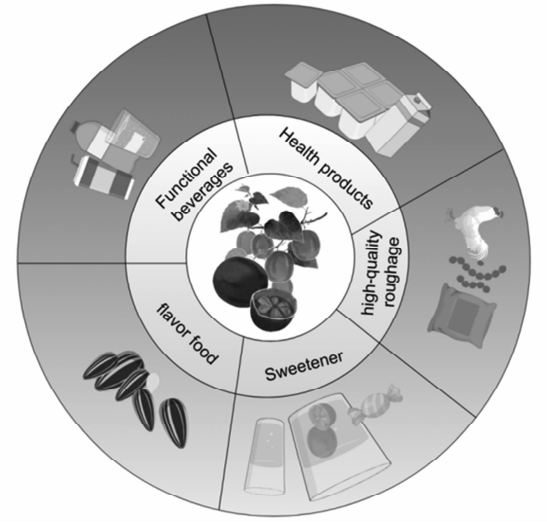


Fig. 2 Food development and application of Luo Han Guo

4.1 Natural sweeteners Mogroside has the characteristics of high sweetness and low calorie content. It is a high-quality natural sweetener. It has high sweetness, good safety, and does not affect blood glucose levels. Compared with glucose, the sweetness of Mogroside IV, Mogroside V, and Saimenoside I is 392, 425, and 563 times that of glucose, respectively[62]. The sweetness of 1% Mogroside V is approximately four times that of sucrose, making it an ideal substitute. The content of Mogroside V in fresh mature Mogroside V is 0.3% – 0.5%, while that in dry mogroside V is approximately 1.0%, which has a very significant sweetness[63]. The common extract specifications of Luo Han Guo in the market are that the content of Mogroside V is 20% – 25% and 50% – 60%. The former retains part of the natural flavor of Luo Han Guo and plays a role in sweetening and enhancing the flavor, while the latter only retains the sweet taste of Luo Han Guo, which is slow but long-lasting for a long time[64].

Song *et al.* [65-66] used mogroside instead of sucrose, supplemented by stevioside and xylitol to prepare zero-sucrose yogurt. Li[67-68] used mogroside as a sweetener combined with wild jujube to make soft candy, and the resulting product performed well in terms of sensory and sweetness. Mogroside has been proven to be a better natural sweetener than sugar, providing a reference for the development and application of sweeteners.

4.2 Functional components Luo Han Guo can be used to develop functional drinks with health benefits; mogroside and its extracts have good antioxidant activity. Peng *et al.* [69] studied the fermentation process of low sugar mogroside goat milk, it has a fine taste and low fat content, making it more suitable for people with diabetes and obesity. This milk has high DPPH and ABTS free radical scavenging rates and good antioxidant activity. Abdel *et al.* [70] found that probiotic yoghurt added with Luo Han Guo extract contained more Lactobacillus casei and Lactobacillus bulgaricus, which improved the antioxidant, ACE-I and antibacterial activities of yoghurt. Xu *et al.* [71] developed the instant tea of Luo Han Guo, black plum and hawthorn, which is a health drink with the functions of reducing weight, lowering blood sugar, improving constipation, *etc.* Lei *et al.* [72-76] found that mogroside V can promote microbial fermentation, thereby enhancing the fruity aroma of Qingti liquor.

The above research shows that mogroside and its extracts have good antioxidant activity, which provides a scientific basis for the production of functional drinks with high nutrition and high biological activity.

5 Conclusions and prospects

Based on the research of other scholars, this review elaborates on the different drying technologies of Luo Han Guo and the in-depth study of food and drug was expounded. Luo Han Guo is one of the first medicinal and food homologous traditional Chinese medicines in China. The drying technology of Luo Han Guo is a pivotal link determining its quality, bioactive component retention, and efficacy. At present, systematic achievements have been made in mainstream drying technologies, such as SD, HAD, and so on. These studies have clarified the effects of different drying technologies on Luo Han Guo; low temperature, low oxygen, and rapid drying are the key to retaining active components and improving sensory quality. Among these technologies, FD and MVD have good quality, while HAD, MD, and SD are gradually replaced due to quality or efficiency problems. The influence of different drying technologies on Luo Han Guo was revealed from the stability of active components, sensory quality, and other dimensions, providing a scientific basis for the selection of drying technology in industrial production.

According to existing studies, different drying processes influence the content of active components and the pharmacological effects of Luo Han Guo. The antioxidant, hypoglycemic, and anti-inflammatory activities of dried Luo Han Guo fruits are higher than those of fresh fruits as a whole, but the effects of different processing methods on bowel soothing and defecation and on intestinal flora have not been investigated. At the same time, because of the update of its modern drying technology, the active components such as glycosides and flavonoids in Luo Han Guo have high retention, high sweetness and good antioxidant properties. Relying on modern extraction technology, high-purity active components are separated from Luo Han Guo, and used as "natural sweeteners" or "functional components" to integrate into modern food production and application.

However, there is still no food safety standard for the whole fruit of Luo Han Guo, and only mogroside V has been incorporated into the relevant standards as a natural sweetener. There is also little research on the difference in the efficacy of drying processes, and there is a large gap in the research and development of different drying processes by Luo Han Guo in the fields of medicine and food applications. Therefore, this article summarizes this part of

the content, hoping to play a certain role in future research and resource development of Luo Han Guo, and promote its wide application in food, medicine, and other fields.

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