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Research Advance of Oryzanol

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Summary:

Objective To investigate the progress of the study on oryzanol. **Methods** The application, preparation and analytical methods of oryzanol were summarized in the literature published at home and abroad. **Results** The research on the application, preparation and analysis of oryzanol has made great progress. **Conclusion** It is widely used in medicine, food and cosmetics, for example, it can prevent and cure cardiovascular diseases and nervous system diseases. It is still one of the focus of future research.

Key words: oryzanol; Purpose; Preparation; Analysis

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Oryzanol is a kind of fat-soluble vitamin. The content of rice bran is very high, especially in germinated brown rice, so it is also called rice bran^[1]. Oryzanol is a natural organic compound widely found in the seeds of cereal plants. It is a mixture of ferulic acid ester, mainly composed of brassicosterol ferulic acid ester, cycloxyloenol ferulic acid ester and 24-methylene cycloxylopanol ferulic acid ester.

Because it is derived from natural products, it is not only harmless to human body, but also beneficial to health, so it has been widely concerned by people, more favored by clinical medicine. Through a lot of clinical practice, we know that oryzanol has the following effects: Protect skin, reduce blood sugar, inhibit cholesterol synthesis and reduce serum cholesterol content, regulate autonomic nerve and improve gastrointestinal function. In cosmetics, oryzanol has a significant effect on freckles. As a food additive, oryzanol has better antioxidant effect and its safety is much higher than that of synthetic antioxidant(such as butyl hydroxyethyl ether), so it can be widely used as a substitute of synthetic antioxidants in the food field. Because of its wide use, researchers pay more attention to its preparation and analysis, so as to meet the needs of society.

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1 Use of oryzanol

In 1949, OConnor, American, first discovered oryzanol from rice bran, and then researchers from all over the world carried out related studies on it, especially a large number of experimental studies in medicine [8]. The first successful trial production of oryzanol in China was in 1971, and in recent years, great progress has been made in the study of oryzanol.

1.1 The use of oryzanol in medicine

Oryzanol has been widely used in the field of medicine, and it still has a great development prospect. This paper mainly summarizes the clinical use of oryzanol from the aspects of nervous system, cardiovascular system, endocrine system, blood and digestive system, etc.

1.1.1 The nervous system

First of all, it has anti-inflammatory effect. Oryzanol has a certain inhibitory effect on LPO and COX, and has a certain effect on arthritis induced by Freund's adjuvant in rats [9]. Islam [10], Gludoxan SO4 adjuvant induced colon inflammation in mice, and demonstrated that oryzanol may inhibit the nuclear transfer of NF-κB (a very important transcription factor in the expression of pro-inflammatory factor, which can induce the expression of inflammatory factor genes during inflammation) and the activity of NF-κB in macrophages. Thus, the mRNA expression levels of TNF-α, IL-1β, IL-6 and COX-2 were significantly decreased. In addition, Sakai et al. [11] used lipopolysaccharide (LPS) to stimulate human umbilical cord venous endothelial cells (HUVEC) induced inflammation model to study the anti-inflammatory effect of oryzanol, and demonstrated that oryzanol may induce anti-inflammatory effect by inhibiting the activity of NF-κB in vascular endothelial cells. Moreover, oryzanol for patients with neurasthenia and insomnia patients also have certain effect, such as Zhangzhao xia [12] 76 patients with sleep disorders as the research object, its were randomly divided into observation group (given vitamin B and d) and control group (to maintain the original state of life and treatment), observe two groups of patients with sleep. The result of this study is that the improvement rate of sleep quality in the observation group was 89.47%, while that in the control group was only 21.05%. In addition, the experimental observation showed that the efficacy of sibelium, propranolol combined with oryzanol in the treatment of neurotic headache was better than that of the first two drugs alone, and the adverse reactions were less, which could effectively improve the clinical symptoms and prognosis of patients [13], thus the oryzanol in treating neuropathic headache also has certain curative effect .

1.1.2 Cardiovascular system

With the improvement of living standard, more and more people suffer from hyperlipidemia.

Oryzanol has the effect of lowering blood lipid mainly because it can inhibit the synthesis and absorption of cholesterol and accelerate the alienation and excretion of cholesterol [14-16] .

Later, Ghattak et al.[17] studied the experimental model of acute hyperlipidemia in mice and found that oryzanol could significantly reduce the serum LDL, VLDL and total cholesterol, and significantly increase the serum HDL and liver antioxidant enzyme activity in rats through the experimental model of acute hyperlipidemia. And the atherosclerotic index also decreased. It can be concluded that oryzanol has a great prospect in the treatment of hyperlipidemia and atherosclerotic diseases.

Secondly, anti-arrhythmia effect. Peng Jiageng et al. [18] adopted clinical research experiments, taking patients with arrhythmia as the research objects, and adopted oral oryzanol tablets for treatment.

Through the study, the total effective rate of the patients was 88.33%, in which the response rate of cardiac

abnormalities caused by autonomic neuropathy was 100%, and the response rate of atrial fibrillation was 86.11%. Therefore, it can be seen that oryzanol may be used to treat arrhythmias by regulating vegetative nerve, reducing endocrine balance disorder and improving body metabolism. When used in combination with other drugs, it is sometimes more effective against arrhythmias and has fewer adverse reactions. For example, the combination of oryzanol with vitamin B1 and compound salvia miltiorrhiza injection has achieved a good therapeutic effect without the side effect of anti-arrhythmic drugs, and has a certain protective effect on myocardial cells, thus meeting the requirements of modern people to pursue a high-quality life [19].

1.1.3 Blood and digestive system

Firstly, it has anti-thrombotic effect. Zhang Wei et al. [20], through experimental study on mice, found that oryzanol can inhibit ADP-induced platelet aggregation and inhibit the formation of thrombus. Secondly, oryzanol also plays a certain role in ulcer and gastritis, especially when combined with other drugs, it has a better therapeutic effect on ulcer. For example, oryzanol combined with metronidazole can reduce the stimulation of gastric acid on gastrointestinal mucosa and thus accelerate the healing of ulcer [21]. In addition, clinical studies have also found that the combination of oryzanol and gastrointestinal motility inhibitors can be used for the treatment of irritable bowel disease, for example, the combination of oryzanol and trimebutine maleate can significantly improve the clinical treatment effect and reduce the incidence of adverse reactions [22].

1.1.4 Endocrine system

Hypoglycemic effect. Chou et al. [23], taking mice as the research object, induced II type diabetes in mice by intritoneal injection of niacyl and streptozotocin (STZ) amine, and then treated with oryzanol, which resulted in the reduction of blood glucose in mice, indicating that oryzanol can enhance the body's sensitivity to insulin and achieve the hypoglycemia effect. The hypoglycemic mechanism of oryzanol is not to increase the secretion of insulin, but to improve the body's immunity and sensitivity to insulin by regulating the autonomic nerve. Ghattak et al. [24] further studied the hypoglycemic effect of oryzanol through cell experiments, and found that the antioxidant effect of oryzanol was related to the treatment of diabetes, indicating that oryzanol may be used as an antioxidant supplement to treat diabetes in the future. In addition, many studies have shown that oryzanol can also be used to treat women's menopausal syndrome, because it can act on the hypothalamus and limbic system of the brain, balance the endocrine system, and affect the synthesis and release of hormones (such as luteinizing hormone, prolactin, etc.) [25-26]. Tao Huizhong et al. [27] reported that the combined use of Guweizu and Yangxue Nao granules in the treatment of menopausal syndrome can play a significant synergistic effect, and it is one of the effective treatment methods with convenient use, economic benefits and no adverse reactions.

1.2 The use of oryzanol in food

Many studies have shown that oryzanol also has a wide range of uses in food, especially in functional food, because oryzanol can reduce blood lipid and prevent dysregulation of body rhythm. At present, oryzanol products used as functional food include oryzanol capsules or pills, oryzanol nutritional oil and oryzanol drinks. Secondly, the antioxidant properties of oryzanol can be used as food additives, such as bread, biscuits, dairy products and meat products, to prevent food rancidity, mildew and extend shelf life. In addition, oryzanol can also keep vegetables and fruits fresh [2,28].

1.3 The use of oryzanol in cosmetics

In 1960, Tokyo Pharmaceutical Company of Japan produced cosmetics containing oryzanol, which was the first application of oryzanol in cosmetics. Subsequently, many companies began to develop cosmetics containing oryzanol. It is now recognized as a special cosmetic material for the skin, mainly because it can absorb ultraviolet light and can be used in sunscreen. It also has the effect of anti-oxidation, which can protect the easily oxidized components in cosmetics. Oryzanol can also inhibit the formation of melanin, so it can be used in the production of feckle-removing, spot-lightening and whitening cosmetics; In addition, oryzanol is also used in cleanser and pearl gloss cosmetics. Therefore, it can be seen that oryzanol is favored by people in the cosmetics industry [1,7].

2 Preparation of oryzanol

Many methods for preparing oryzanol have been reported in the literature. Rao et al. [29] applied six-step method to extract oryzanol from rice bran oil soapstock, and column chromatography, crystallization and recrystallization were also used in the process to obtain oryzanol with a purity of 90% (W/W) and a yield of 56% ~ 70% (W/W). Indira et al. [30] adopted the extraction method, taking rice bran oil soapstock as raw materials, after secondary saponification and dehydration, and then extraction, with a purity of 40%-45% (W/W) and a yield of 80% (W/W). This method has the advantages of less operation, mild reaction conditions and suitable amplification. In 2007 and 2009, a review was published on the methods of the preparation of oryzanol. This paper will not repeat it here, but will only summarize the commonly used methods.

2.1. Weak acid substitution

In this method, the target compound oryzanol was separated by the property of oryzanol soluble in alkaline methanol and ethanol but insoluble in acid methanol and ethanol.

After two alkali smelting, the oryzanol dissolved in rice bran oil is enriched in the soapstock, and then the soapstock is dissolved with alkaline methanol to precipitate out the impurities that hinder the precipitation of oryzanol. Then the pH value of the filtrate is adjusted to a weak acid, and the sodium salt of oryzanol is reduced to oryzanol precipitation and precipitated out. This method has the advantages of fewer procedures, short time spent, simple equipment used and low cost, but low yield [31].

2.2 Methanol extraction method

In this method, the crude rice bran oil was directly dissolved in alkaline methanol for saponification, and then the insoluble unsaponified matter was filtered out, the filtrate was adjusted to a weak acid, and the sodium salt of oryzanol was reduced to oryzanol sediment and precipitated.

Compared with the previous method, this method eliminates the process of alkali refining, avoids the loss of oryzanol in the process of alkali refining and saponification, and improves the recovery rate of oryzanol [32].

2.3 Non-polar solvent extraction

The principle of non-polar solvent extraction is to separate purified oryzanol by using non-polar solvents to dissolve oryzanol at different pH levels. By simply adjusting the pH of the solvent, the method obtains a higher purity oryzanol, as well as non-saponified substances such as vitamin E and sterols.

3 analytical method of oryzanol

The original method of analysis of oryzanol is the photophototonic method. In 1989, the Chinese Pharmacopeia promulgated the Ultraviolet Spectrophotometry Method (UV) to determine the content of oryzanol method standard. This method has not been updated yet [33]. With the development of science and technology, some advanced analytical techniques will gradually be used to analyze and detect oryzanol. In this paper, the application of UV, near-infrared spectroscopy (NIRS) and high-efficiency liquid chromatography (HPLC) in oryzanol analysis and testing is reviewed.

3.1 UV

UV is the most commonly used analytical method, which is simple in operation and low in cost, but its specificity is poor, so it is widely used in the purity detection of oryzanol, the determination of effective components in oryzanol tablets and the rough determination of oryzanol content in rice bran oil. Liu Genggui et al. [34] used UV method with an absorption wavelength of 315 nm to determine the content of oryzanol in the oil residue and soap stock produced by rice bran from different producing areas and different refining processes, providing a reference for enterprises producing natural ferulic acid.

3.2 NIRS

NIRS is a new nondestructive testing method. It is characterized by fast analysis speed, high efficiency, no pollution, no destructiveness, low cost, easy operation, etc., so it has been widely used in many fields. Kaeworn et al. [35] used NIRS for the first time to analyze and determine oryzanol in germinated brown rice. The samples used were germinated brown rice soaked for 24 h or 48 h and then cultured for 0, 6, 12, 18, 24, 30, 36 and 48 h in Polypropylene bag, respectively. The germinated brown rice was processed by near infrared light scanning, and the prediction model was established by partial least square regression (PLSR) and verified by complete cross validation. The correlation coefficient (R^2), root mean square error (RMSECV) and deviation of the established NIRS model were $0.934 \times 10^{-5} \text{ mg} \cdot 100\text{g}^{-1}$, $8.84 \times 10^{-5} \text{ mg} \cdot 100\text{g}^{-1}$ and $1.06 \times 10^{-5} \text{ mg} \cdot 100\text{g}^{-1}$, respectively. This method is of great value to the germinating brown rice producers and consumers.

3.3 HPLC

This method is a widely used analytical method at present, the principle of which is to draw a standard curve with the oryzanol standard substance as the external standard, and then calculate the content of oryzanol in the sample, which is characterized by high sensitivity, detection limit, strong specificity. Xu Ran et al. [36] used HPLC to determine the content of oryzanol in different varieties of rice bran oil. The chromatographic conditions were ZORBAXNH₂ column (5m×4.6mm×250mm), column temperature 40°C, UV detector wavelength 324nm, mobile phase was anhydrous ethanol, flow rate 0.8 mL·min⁻¹. The injection volume was 10 L; The method uses Zorbax NH₂ column instead of the conventional C18 bonded silica gel column, because the Zorbax NH₂ column has a lower degree of contamination to the sample and allows the same retention time for each components of oryzanol. The content of oryzanol in rice bran of different varieties was investigated, which provided a reference for the selection of planting resources and the production of oryzanol.

4 Outlook

To sum up, oryzanol has a wide range of uses and many benefits to human health. With the improvement of living standards, people pay more and more attention to health care. As a non-toxic and harmless natural organic compound, oryzanol will be welcomed by more and more consumers. Therefore, it still has a great development prospect in the fields of medicine, food and cosmetics, especially as a functional food. In order to obtain high quality and low price oryzanol, the preparation and analysis technology of oryzanol will still have a great prospect. Therefore, in the future, the study on the use, preparation and analysis of oryzanol is still one of the hot spots of scholars.

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