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Study on Antibacterial Activity of Kiwifruit Active Extract

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Abstract: The main bioactive substances of kiwifruit include triterpenoids, flavonoids, polysaccharides, endophytes and so on. Modern studies have shown that kiwifruit root and fruit polysaccharides, triterpenoids containing carboxyl groups and flavonoids have strong antibacterial activity and effective anti-tumor pharmacological effects; endophytic fungi have new cytotoxicity and anti-tumor biological activity; endophytic bacteria have obvious antibacterial activity, especially inhibiting the growth of Gram-negative bacteria; kiwifruit seed oil, polyphenols, flavonoids, unsaturated fatty acids and vitamin C have obvious antioxidant stress ability; kiwifruit juice ch has antioxidant and anti-inflammatory effects on type 2 diabetes mellitus (T2DM); kiwifruit seed oil can reduce blood sugar and improve insulin resistance. In this paper, kiwifruit was selected as the research object, and the active extract of kiwifruit and the mechanism of inhibiting pathogenic bacteria were reviewed in order to provide a certain reference for the development and application of kiwifruit in medical, food and beauty fields in the future.

Keywords: Kiwifruit; Active extract; Bacteriostatic activity; Endophyte

1. Introduction

Kiwi fruit is a kind of nutritious fruit, but also good for digestion, immunity and metabolic health. Kiwifruit is abnormally high in vitamin C and contains a range of other nutrients, especially dietary fiber, potassium, vitamin E and folic acid, as well as a variety of bioactive components, including various antioxidants, Phytonutrients and enzymes, which provide functional and metabolic benefits [1]. At present, the application of kiwi fruit in the development of medical and health products has become a new research hotspot in medicine and life science. In addition, some substances in kiwifruit can scavenge free radicals and delay aging by activating antioxidant enzymes in the body. Polyphenols are related to their ability to scavenge free radicals. In this paper, the antibacterial activity of kiwifruit active extracts is summarized as follows.

2. Kiwifruit Active Extract

Kiwifruit is rich in bioactive substances, including triterpenoids, saponins and phenolic compounds (flavonoids, polyphenols, anthraquinone and coumarin), etc. these bioactive substances have certain advantages in anti-tumor, anti-cancer, detoxification and liver protection, anti-oxidation and aging and enhancing immunity [2].

2.1. Endophytic fungi of kiwifruit

The endophytic fungi of kiwifruit were isolated and identified for the first time, and a total of 17 fungal isolates were obtained. The results of MTT assay showed that 82.4% of the broth showed growth inhibition (IC 50 < 100 μ g / ml). In addition, am07, AM11 and am17 showed strong antitumor activity in all cell lines examined. These results indicate that A. macrosperma is an isolated and novel cytotoxic and antitumor bioactive agent [3].

2.2. Endophytic fungi in kiwi fruit

Three strains of endophytic bacteria were isolated from kiwifruit pulp, and one strain with obvious antibacterial activity was identified as Enterobacter faecalis, which could inhibit the growth of standard strains of Escherichia coli, Staphylococcus aureus and Gram-negative strains such as Escherichia coli, Enterobacter cloacae and Klebsiella pneumoniae The growth of cocci, hemolytic Staphylococcus and Streptococcus pneumoniae had no effect [4].

2.3. Kiwifruit root

Kiwifruit plan roots is a kind of traditional Chinese medicine, which has anti-tumor and detoxification effects, diuretic and hemostatic effects. Acroots treatment can strongly inhibit tumor growth in various forms of cancer. Acroots inhibits the malignant biological behavior of HCC cells by regulating epithelial mesenchymal transition (EMT) through Dlx2 [5].

2.4. Polysaccharides in roots and fruits of kiwifruit

2.4.1. Root polysaccharide

Basile et al. [6] Found that kiwifruit root extract had strong antibacterial activity against Gram-positive bacte-

ria. It has also been found that polysaccharides from the roots of Actinidia chinensis (APT), an effective antitumor and immune adjuvant, activate RAW264.7 macrophages through TLR / NF - κ B signaling [7].

2.4.2. Fruit polysaccharide

A new type of cell wall polysaccharides (AAPS) was isolated from kiwifruit and divided into four parts: water washed polysaccharides (WPS), salt eluting polysaccharides (SPS) - 1, sps-2 and sps-3. Analysis of monosaccharide composition and structure showed that sps-3 and sps-2 were pectin rich in high galacturonic acid (Hg), sps-1 was pectin rich in rhamnogalactosan (RG), and WPS was amyloid polysaccharide. The four polysaccharides have the ability to scavenge free radicals, chelate iron ions, inhibit lipid peroxidation and protein glycosylation, but SPS is significantly stronger than WPS. In particular, sps-3 showed the strongest antioxidant and anti saccharification activities [8].

2.5. Kiwi polypeptide

Kissper is a kiwifruit peptide, which has been found in different amounts of green kiwifruit [9]. It is derived from the hydrolytic cleavage of strange protein, the precursor of protein, which is one of the most abundant protein components in this fruit. In the synthetic lipid bilayer, it showed pore forming activity, and its composition was similar to that in intestinal cells. Kissper reduced the phosphorylation of NF - κ bp65 and the release of proinflammatory cytokines (such as TNF - α and COX-2 or ICAM-1) in monocytes [10].

2.6. Flavonoids from kiwifruit

Flavonoids can change the cell morphology of some bacteria and inhibit the synthesis of DNA and RNA in bacterial cells. At the same time, protein synthesis is also significantly inhibited or delayed. Therefore, flavonoids have direct antibacterial, synergistic antibacterial and bacteriotoxic effects [11].

2.7. Kiwi seed oil

The unsaturated fatty acids in kiwifruit seed oil enhance the antioxidant stress ability of rats with pulmonary fibrosis by activating keap 1 / NRF 2 signaling pathway. The degree of alveolitis and pulmonary fibrosis was 60120180 mg / kg. The levels of Hyp, ROS and MDA in lung tissue were significantly decreased, the expression of Kee 1 protein in cytoplasm was significantly decreased, while the contents of SOD, cat and GSH PX were decreased in lung tissue [12].

2.8. Actinidia root bark (ACRB) extract

EtOAc extract with the highest activity was isolated from the extract of actinidia root bark (ACRB). Among them, 5-methoxycoumarin-7 - β - D-glucosidase and Spa acid 28-o - β - d-glucopyranoside were the main active components, which had the potential of further development as biological anti-virus agents [13].

2.9. Triterpenoids

At present, triterpenoids have been the main research focus of Chinese animal and plant components because of their good antitumor properties. So far, 42 triterpenoids have been isolated and identified, mainly from the roots of Aspergillus sinensis. The common triterpenoids found in the roots of Aspergillus sinensis are dodecane and ursolic type 12-en-28-oic acid. It is worth noting that some of these triterpenoids (1-2, 7, 15-18, 21, 25-26, 29-30 and 34-40) have significant antitumor activities and deserve further research and development [14].

3. The Possible Mechanism of Kiwifruit Kiwifruit Active Extract Inhibiting Pathogenic Bacteria

3.1. Antioxidant mechanism

Kiwifruit has a variety of activities; antioxidant activity is one of the most important. The antioxidant capacity of kiwifruit is largely attributed to polyphenols, flavonoids, unsaturated fatty acids and vitamin C. In addition, different extraction methods, different plant parts and genetic diversity also showed different antioxidant activities. The peel showed the strongest antioxidant activity, followed by pulp and core. The antioxidant activity of kiwifruit peel mainly depends on a variety of phenolic substances, and the antioxidant activity of pulp is mainly attributed to the presence of vitamin C [15]. Moreover, oral kiwi fruit can protect lymphocytes from DNA oxidative damage, inhibit lipid oxidation in mice, increase SOD and GSH, and reduce ALT and AST levels of patients.

The ethanol extract of kiwifruit is rich in phenols, flavonoids and vitamin C. The ethanol extract of kiwifruit also showed strong hydroxyl radical scavenging activity and O 2 - free radical scavenging activity and antiproliferative activity in HepG2 and HT-29 cells. This inhibition of cancer cell proliferation is at least partly due to the antioxidant activity of the extracts. Therefore, kiwifruit may be a potential source of natural antioxidants.

In addition, the inhibitory effect of cell wall polysaccharides (AAP) on ages formation is attributed to the inhibition of protein carbonyl production and the protection of protein sulfhydryl, rather than the ability to scavenge dicarbonyl compounds, which indicates that the mechanism of anti glycosylation may be their antioxidant activity, which deserves attention.

Meanwhile Kiwifruit juice has the function of scavenging free radicals and ant oxidation. Kiwifruit juice can inhibit lipid peroxidation of red blood cells and reduce the production of malondialdehyde (MDA).

3.2. Mechanism of anticancer and anticancer action

The treatment of Actinidia chinensis planroots (acloots) and acloots (10 mg / ml) had no cytotoxicity on L02 cells, but had a positive effect on L02 cell viability. However, it significantly inhibited the proliferation of HCC cells. Acloots treatment can down regulate the expression of Dlx2 gene in HCC cells, and the high expression of Dlx2 is related to the late stage and poor prognosis of HCC patients. Acloots treatment can inhibit Dlx2 expression, thereby inhibiting proliferation, invasion and migration, clonality, epithelial to mesenchymal transition, and promoting apoptosis of HCC cells. HCC cells with higher Dlx2 expression were more sensitive to acloots.

A new polysaccharide compound (ACPS-R) was isolated from the roots of kiwifruit recently. The tumor inhibition rate of Ehrlich ascites (EAC) or hepatoma ascites (HEPA) was more than 88.8% when intraperitoneal administration of 75-125 mg / kg of transplantable tumor mice. Acps-r also prolonged the life span of mice with eac or P388 and increased the percentage of mice without EAC. In addition, when acps-r is combined with 5-FU, its antitumor effect is enhanced compared with 5-FU alone.

In addition, a large number of triterpenoids were extracted from the roots of kiwifruit, especially those containing carboxyl group, which had obvious cytotoxicity to various types of cancer cells in vitro. In particular, compounds 1-2, 7, 15-18, 21, 25-26, 29-30, 34-40 and 43-46 have significant antitumor activities against A549, HepG2, Lvov, MCF-7, HeLa and / or HepG2 in vitro ; in vivo, a polysaccharide extracted from kiwifruit root has antitumor activity, which can prolong the life span of EAC or P388 cells and inhibit DNA synthesis of EAC cells.

3.3. Lipid lowering and anti diabetes activities

Application of fatty acid rich Chinese rapeseed oil at 1.0 and 3.0 ml / kg · BW per day for 12 consecutive weeks significantly reduced weight gain, groin adipose tissue weight and accumulation of TC, TG, HDL-C and LDL, and - C in liver of obese C57BL / 6 mice induced by high-fat diet. At the same time, long-term consumption of Zhonghua rape seed oil increased the expression of PPAR - γ, UCP1, PGC1 - α and PRDM16 genes, down regulated the expression of Fas, and changed the intestinal flora. In addition, seed oil from Aspergillus sinensis improved insulin resistance and alleviated hyperglycemia by reducing HOMA-IR index and blood glucose in obese mice induced by high-fat diet.

Some studies have shown that kiwi fruit juice ch has antioxidant and anti-inflammatory effects on type 2 diabetes mellitus (T2DM). The juice increased the serum microrna-424, Keap1 and Nrf2 levels, and decreased the levels of interleukin-1 (IL-1) β and IL-6. Compared with the patients who did not take fruit juice, the contents of SOD and GSH were higher, while the contents of ALT and AST were lower. Therefore, fjacp can activate Keap1 and Nrf2 by up regulating the activation of miR-424 in T2DM patients, thus improving the indicators of antioxidant and anti-inflammatory status.

3.4. Kiwi fruit polysaccharide can resist hypoxia induced cardiomyocyte apoptosis in vitro

Actinidia chinensis polysaccharide (ACP) is the main active component of Actinidia chinensis. Flow cytometry analysis showed that ACP inhibited hypoxia induced cardiomyocyte apoptosis induced by Ang II. In addition, RT-PCR and Western blot showed that ACP reduced the expression of apoptosis related genes, including apoptosis inducing factor mitochondrial associated 1, caspases-3 / 8 / 9 and cleaved caspases-3 / 8 / 9. The results also showed that ACP inhibited the activation of ERK1 / 2 and PI3K / Akt signaling pathways. In addition, the specific activation of ERK1 / 2 and PI3K / Akt reversed the inhibitory effect of ACP on apoptosis. In conclusion, the protective effect of ACP on hypoxia induced apoptosis may depend on the inhibition of ERK1 / 2 and PI3K / Akt signaling pathways in Ang II treated cardiomyocytes. RT-PCR and Western blot showed that ACP reduced the expression of apoptosis related genes, including apoptosis inducing factor mitochondrial associated 1, caspases-3 / 8 / 9 and cleaved caspases-3 / 8 / 9.

3.5. Mechanism of antibacterial activity of Kiwifruit

All extracts, including skin, pulp, seeds and stems, are fungicidal against Staphylococcus aureus, Streptococcus pyogenes, Streptococcus faecalis, Salmonella typhi, proteus, Pseudomonas aeruginosa, Escherichia coli and Klebsiella pneumoniae. The skin and pulp extracts showed inhibitory activities against Staphylococcus aureus and Streptococcus pyogenes with MIC values of 8 and 4 μ g / ml, but they had MIC values of 16 to 128 μ g / ml against Streptococcus faecium, Salmonella typhi, Pseudomonas mirabilis, Pseudomonas aeruginosa, Escherichia coli and Klebsiella pneumoniae [26]. The extracts from leaves and stems could only inhibit Streptococcus pyogenes and Pseudomonas aeruginosa with MIC values of 64 and 32 μ g / ml, respectively. The seed extract showed unique antimicrobial activity against these selected bacterial strains with MIC values ranging from 1 to 8 μ g / ml. Polyphenols from kiwifruit seeds have significant bactericidal effect on Bacillus cereus, Bacillus subtilis, Shigella flexneri and Salmonella typhi, and Bacillus thuringiensis. We found that the antibacterial activity of polyphenol extracts against Gram-positive bacteria was higher than that of Gram-negative bacteria.

There are also experiments the volatile oil from kiwifruit was extracted by steam distillation and analyzed by gas chromatography-mass spectrometry (GC-MS). The results showed that the extraction rate of volatile oil was 1.04%. 36 components were obtained by GC-MS, ac-

counting for 87.82% of the total content. DPPH scavenges free radicals, H_2O_2 The scavenging rate and total reducing capacity of volatile oil were good, and had strong antioxidant activity. It could effectively inhibit the growth and reproduction of Staphylococcus aureus, Bacillus subtilis and Saccharomyces cerevisiae. But it has no obvious inhibitory effect on E. coli. It can be considered that the volatile oil has certain antibacterial activity.

3.6. Anti inflammatory mechanism of kiwifruit

The anti-inflammatory activity of kiwifruit has been proved in vivo and in vitro. In the high-fat diet induced obese C57BL / 6 mice model, continuous down-regulation of 1.0 and 3.0 ml/ Kg · BW of kiwifruit rape seed oil can reduce the inflammation caused by obesity by down regulating the mRNA expression related to inflammatory fatty factors, such as TNF - α, IL-6, IL-1 β, COX-2 and iNOS; water and ethyl acetate extracts showed anti-inflammatory activity in IL-10 gene deficient mice with inflammatory bowel disease;
In type 2 diabetic patients, kiwi fruit juice can prevent inflammation by up regulating miR-424 and activating Keap1 and Nrf2;
At the cellular level, the polyphenols with protocatechuic acid, p-hydroxybenzoic acid, p-coumaric acid, caffeic acid and ferulic acid as the main components could inhibit the secretion of pro-inflammatory cytokines IL-1 β and TNF - α in raw 264.7 cells induced by LPS after 12 h treatment with 40 μ g / ml and 60 μ g / ml;
Therefore, the anti-inflammatory potential of kiwifruit mainly depends on the synergistic effect of these polyphenols and can be used to prevent a variety of inflammatory related diseases.

3.7. Hypnotic effect

Oral administration of 250, 500 and 1000 mg / kg of ethanol extract of Aspergillus sinensis significantly reduced the sleep latency and increased sleep time in pentobarbital treated mice. In particular, the ethyl acetate fraction rich in 250 mg / kg flavonoids (1.63 mg QE / g) in sequence has obvious hypnotic effect, which can be inhibited by flumazenil, a gabaa-bzd receptor antagonist.

4. Epilogue

More and more research data and consumers' understanding of kiwifruit health benefits are increasing. The chemical composition of Kiwifruit in China has gradually made a breakthrough, especially in the aspect of antibacterial research. But at present, the mining of kiwifruit antibacterial mechanism is still a hot issue. China is the country of origin of kiwifruit, kiwifruit is rich in wild resources. We should grasp the golden research object of kiwifruit, so as to develop better drugs and health products.

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