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REGULAR ARTICLE

Molecules and functions of *Cornus officinalis* bark volatiles

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ABSTRACT

Cornus officinalis Sieb. et Zucc is a traditional Chinese valuable medicinal material. Clinically, it is customary to use ripe fruits from which seeds have been removed for medicinal purposes. The pulp contains 16 amino acids and a large number of essential elements for the human body. In recent years, with the expansion of the application of cornus officinalis, its pharmacological and pharmacological effects have been increasingly studied. At present, significant achievements have been made in the study of the bioactive components of cornus officinalis. The research of these achievements has been based on the research of the fruit of cornus officinalis. The study of branches or bark of cornus officinalis is very rare. With the fruit of cornus officinalis getting more and more attention, in order to solve the problem of the shortage of cornus officinalis fruit in the market, in this paper, starting from the study of bark of cornus officinalis, TGA-DTG and PY-GC-MS analysis methods were used to study the weight loss and pyrolysis of cornus officinalis bark, providing a basis for more fully utilizing cornus officinalis resources. With reference.

Keywords: *Cornus officinalis* bark; Volatiles; Value utilization; PY-GC-MS; TGA-DTG

INTRODUCTION

Cornus officinalis Sieb. et Zucc, the original plant is a deciduous tree or shrub, which is mainly distributed in the north of the Yangtze River in China, in the middle and lower hills of the Qinling Mountains, the south of the Funiu Mountain and the Tianmu Mountain in Zhejiang, and its main planting province is Zhejiang, Henan, Shandong, Anhui and other places (Zhao, 1992; Hong, 2003; Han, 2005). Cornus officinalis contains various chemical components such as volatile oils, organic acids and iridoid glycosides, and has a variety of pharmacological activities (Khan, 2018; Hasan, 2018; Howlader et al., 2018). According to traditional Chinese medicine, cornus officinalis has the effect of tonifying liver and kidney, astringent essence, and modern pharmacology research shows that cornus officinalis has various clinical features such as hypoglycemic, anti-bleeding, platelet aggregation inhibition, anti-inflammatory, anti-oxidation, antibacterial and anti-tumor effects (Ren, 2016; Huang et al., 2017; He et al., 2016; Miyazawa et al., 2014; Cao and Lei, 2013). Efficacy. In recent years, the study of its chemical composition has also been carried out in depth (El Toum, 2018; Khan et al., 2018). Studies have shown that in the decontamination study of Bawei Pills, only cornus officinalis has hypoglycemic effect on streptozotocin-induced rat model of diabetes (Ma et al., 2014; Qian et al., 2001; Chen et al., 2016) cornus officinalis can kill ascites cancer cells in vitro. Clinically used for radiotherapy, chemotherapy, leukopenia, primary liver cancer, metastatic liver cancer (Telang et al., 2016; Miyazawa and Kameoka, 2014; Telang et al., 2012), etc.; In addition, ethanol extract cornus officinalis can significantly reduce normal blood glucose, serum total cholesterol and triacylglycerol; and cornus officinalis Oleanolic acid has a slight cardiac diuretic effect and is also clinically used to treat acute viral hepatitis (Hsu et al., 2006; Wang et al., 2007; Jang et al., 2014).

In this paper, the bark of cornus officinalis as the research object, the bark was dried and made into powder, and analyzed by TGA-DTG and PY-GC-MS. It provides scientific research on the utilization of cornus officinalis from a new perspective and direction in accordance with.

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MATERIAL AND METHODS

Experimental materials

Cornus officinalis bark was obtained from Nanyang City, Henan Province, Xixia County Forest Farm. Place the bark in a 100°C oven until absolutely dry. Then use a pulverizer to break the bark as a sample to be tested.

Experimental methods

TGA-DTG analysis

The sample of the fruit of Cornus officinalis were analyzed viathermogravimetric analyzer (TGA Q50 V20. 8 Build 34). The nitrogen release rate was 60 ml/min. The temperature program of TG started at room temperature and increased to 300°C at a rate of 5°C/min (Kok et al., 2016; Gornicka and Gorecki, 2010; Trivedi et al., 2017).

PY-GC-MS Analysis The fruit of cornus officinalis was analyzed viathermal cracking-gas chromatography-mass spectrometry (CDS5000-Agilent7890B-5977A). The carrier gas was high purity helium, the pyrolysis temperature was 500°C, the heating rate was 20°C/ms, and the pyrolysis time was 15s. The pyrolysis product transfer line and the injection valve temperature were set to 300°C; Column HP-5MS; Capillary column (30m×0. 25mm×0. 25μm); Shunt mode, split ratio of 1:60, shunt rate of 50mL/min. The temperature of the GC program started at 40°C for 2 min, increased to 120°C at a rate of 5°C/min, and then increased to 200°C at a rate of 10°C/min for 15 min. Ion source (EI) temperature of 230°C, scanning range of 28-500amu (Jiang et al., 2017; Xie et al., 2017; Lu et al., 2011; Ross et al., 2009).

RESULTS AND DISCUSSION

Analysis of TGA and DTG

In order to study the thermal decomposition of active ingredients in the bark of cornus officinalis, we conducted a TGA test on the bark. Figure 1 shows the TGA curve and DTG curve of the bark of cornus officinalis. T5wt% and T20wt% represent 5% and 20% of the weight loss, respectively (Hu and Huang, 2000; Shuyi et al., 1998; Lin, 2004). According to the graph of Fig. 1, we can obtain T5wt% and T20wt% respectively at 61°C and 275°C. According to the thermogravimetric curves of the bark of cornus officinalis, the thermogravimetric analysis process is roughly divided into three stages. The first stage is 20-80°C. The main reaction at this stage is the evaporation of part of the water molecules and small molecules with lower boiling points at elevated temperatures. The quality ratio at this stage dropped from 100% to 93%. The mass loss is T7wt%. The DTG curve at this stage gradually increased from a lower value and reached a peak value at 48°C. At this time, the cracking rate reached the fastest,

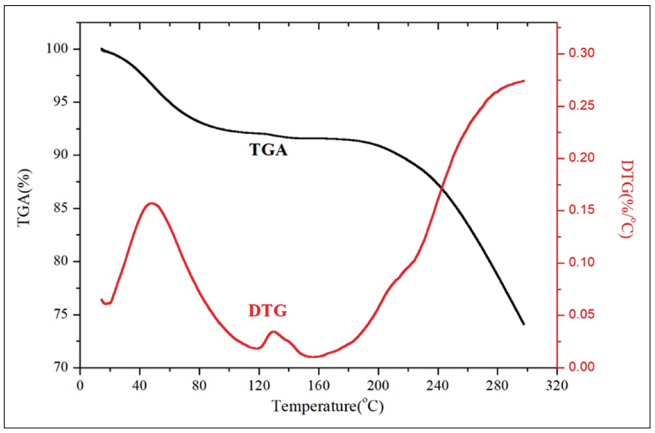

Fig 1. TGA and DTG thermal curves of C. officinalis bark.

and then began to gradually decline (Arsenovic et al., 2013; Chen et al., 2015; Li et al., 2013). The second phase is 80-200°C. At this stage, a smaller amount of organic molecules begins to decompose, the mass ratio drops from 93% to 90%, and the mass loss is T3wt%. The DTG continued to decline at this stage, with a slight fluctuation at 120°C, and the curve began to rebound after 160°C. The third stage is 200-300°C. As the temperature continues to increase, the organic components continue to undergo severe cracking and the organic components continue to dissipate. The mass ratio dropped from 90% to the final 74%, and the mass loss was T16wt%. At this point, the DTG curve gradually increased, indicating that the rate of cracking continued to increase during this phase. These three stages exhibited different properties and different kinetic parameters and reaction mechanisms, with a final residual mass of 74%. Throughout the three phases, the weight loss in the first phase was 7%, which was mainly due to the evaporation of some moisture molecules that remained; the quality of the second phase remained good and the weight loss was only 3%; after 200°C, the quality began to drop rapidly, and the final remaining 74%. Through the TGA experimental test, the thermal decomposition of the bark of cornus officinalis below 300°C is described, which provides a reference for us.

The total ion chromatograms of the bark of *C.officinalis* samples studied via PY-GC-MS are shown in Fig 2. High-grade resource utilization has been reported by a scholar (Wu et al., 2003; Qingzhi and Peng, 2008; Lou et al., 2018). Furthermore, the relative content of each component has been counted via area normalization. The MS data is analyzed by using the NIST standard MS map and publicly published books and papers, and then identify each component. Moreover, the analytical results of the samples are listed in Table1, respectively.

According to the results of PY-GC-MS analysis, 276 peaks were detected in Table 1, and 276 chemical constituents

were identified. The results show that the content of more substances are as follows: Ethyne, fluoro- (6.54%), R-(-)-Cyclohexylethylamine (2.45%), Acetone (2.08%), Acetic acid (4.62%), 2-Propanone, 1-hydroxy- (1.53%), Phenol, 2-methoxy- (1.06%), Catechol (1.08%), 2-Methoxy-4-vinylphenol (1. 67%), Vanillin (1.03%), trans-Isoeugenol (3.50%), beta.-D-Glucopyranose, 1,6-anhydro- (3.03%), 2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)- (1.60%), (E)-2,6-Dimethoxy-4-(prop-1-en-1-yl)phenol (1.46%), Furfural (0.87%), Creosol (0. 98%), and n-Hexadecanoic acid (0. 99%). The main components of these detected compounds are esters, acids, phenols, anthraquinones and ketones. By analyzing the main functions and functions of different compounds, Cornus officinalis bark can be more effectively and fully utilized and exerted (Zhu et al., 2018; Xue et al., 2017; Grabowska et al., 2017; Tori et al., 2016).

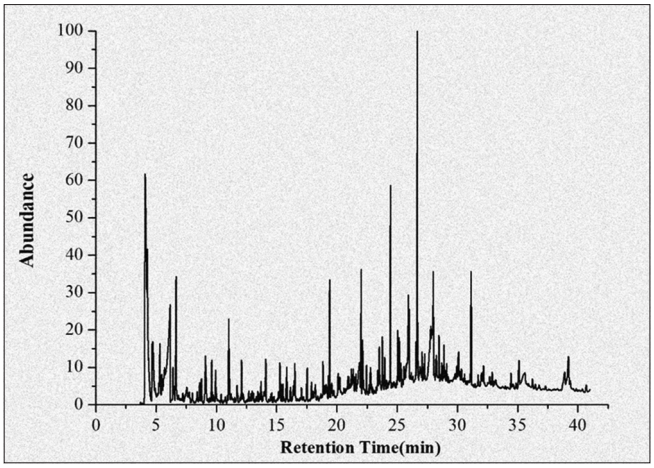

Fig 2. Total ion chromatograms of Cornus officinalis bark via PY-GC-MS.

From Table 1 can be obtained, the identified compounds can be divided into esters, alcohols, carbohydrates, tannins, iridoids, phenolics, ketones, glycosides and organic acids and so on. Among them, Furfural is a colorless, transparent, oily liquid with a special smell similar to benzaldehyde. Exposure to light and air quickly turns red-brown. Easy to evaporate with steam. Furfural is used as a raw material for organic synthesis and is widely used in the synthesis of fine chemicals such as pharmaceuticals, pesticides, veterinary drugs, dyes, spices, rubber chemicals, and preservatives. The largest area of consumption of Furfural is as a raw material for solvents and synthetic resins. Some of Furfural's derivatives have a strong bactericidal capacity and a broad spectrum of inhibition. Furfural, for example, is 5-nitrofurfural, which is condensed with semicarbazide hydrochloride to give furacilillin, a disinfectant antiseptic. At the same time, as a solvent, Furfural can selectively extract the unsaturated components from petroleum and vegetable oils. Furfural is used to extract the aromatic components in lubricating oils and diesel fuels. Improve the quality of these products (Lange et al., 2012; Palmqvist et al., 2015; Mamman et al., 2018; Eranda et al., 2011).

Another compound, phenol, is one of the main components of coal tar. Runge discovered phenol from coal tar in 1834, and Laurent produced crystalline phenol for the first time in 1841. Phenol is an important organic chemical raw material. It can be used to produce phenolic resin, bisphenol A, salicylic acid, pentachlorophenol, 2,4-D, and other chemical products and intermediates in chemical raw materials, synthetic fibers, plastics, Synthetic rubber, pharmaceuticals, pesticides, spices, dyes, coatings and oil refining industries have important applications (Vinson

Table 1: PY-GC-MS analysis of cornus officinalis bark

No.	Retention Time (min)	Peak area (%)	Component
1	3.70	0.03	2-Butanamine, 3,3-dimethyl-
2	3.82	0.00	n-Hexylmethylamine
3	4.08	6.54	Ethyne, fluoro-
4	4.23	0.45	Ethyne, fluoro-
5	4.26	2.45	R-(-)-Cyclohexylethylamine
6	4.36	0.85	Glycidol
7	4.71	2.08	Acetone
8	4.90	0.31	Formic acid
9	5.00	0.06	Formic acid
10	5.14	0.21	2-Propen-1-ol
11	5.23	0.31	Acetaldehyde, hydroxy-
12	5.31	0.78	Acetaldehyde, hydroxy-
13	5.45	0.53	2,3-Butanedione
14	5.61	0.40	Pentane
15	5.70	0.78	Furan, 2-methyl-
16	6.16	4.62	Acetic acid
17	6.25	0.04	3-Vinyl-1-cyclobutene

(Contd...)

Table 1: ***(Continued)***

No.	Retention Time (min)	Peak area (%)	Component
18	6.31	0.05	1,3-Cyclohexadiene
19	6.38	0.39	2-Butenal, (E)-
20	6.47	0.25	Methacrolein
21	6.65	1.53	2-Propanone, 1-hydroxy-
22	6.84	0.12	3-Buten-2-one, 3-methyl-
23	6.95	0.09	1-Butanol
24	7.10	0.11	Acetic acid, cyclohexyl ester
25	7.21	0.19	Heptane
26	7.43	0.19	1,2-Ethanediol
27	7.55	0.43	Furan, 2,5-dimethyl-
28	7.75	0.28	Propanoic acid
29	7.94	0.05	2-Vinylfuran
30	8.01	0.11	Propanoic acid, 2-oxo-, methyl ester
31	8.08	0.03	1-Ethoxypropan-2-yl acetate
32	8.33	0.04	3-Penten-2-one, (E)-
33	8.40	0.18	1H-Pyrrole, 1-methyl-
34	8.61	0.30	Pyridine
35	8.75	0.36	Pyrrole
36	9.08	0.99	Acetic acid, methyl ester
37	9.26	0.10	2-Butenal, 2-methyl-, (E)-
38	9.43	0.11	1-Propanone, 1-(1-adamantyl)-3-dimethylamino-
39	9.62	0.51	Propanoic acid, 2-oxo-, methyl ester
40	9.75	0.17	3-Octene, (Z)-
41	9.93	0.49	1,2-Propanediol, 3-(1-pyrrolidinyl)-
42	10.12	0.06	3-Pyrrolidinol
43	10.38	0.10	3-Furaldehyde
44	10.45	0.04	1H-Pyrrole, 2-ethyl-
45	10.59	0.02	3-Furanmethanol
46	10.65	0.03	Pyridine, 2-methyl-
47	10.73	0.10	Ethanol, 2-[(2-aminoethyl)amino]-
48	10.91	0.07	Propargylamine
49	11.02	0.87	Furfural
50	11.07	0.27	2-Cyclopenten-1-one
51	11.21	0.11	4-Cyclopentene-1,3-dione
52	11.29	0.07	Acetamide, N-(aminoiminomethyl)-
53	11.52	0.07	1H-Pyrrole, 3-methyl-
54	11.71	0.26	2-Furanmethanol
55	11.77	0.09	5,9-Dodecadien-2-one, 6,10-dimethyl-, (E,E))-
56	11.92	0.02	Cis-bicyclo[4.2.0]octane
57	11.99	0.08	Ethylbenzene
58	12.09	0.41	2-Propanone, 1-(acetyloxy)-
59	12.19	0.21	2(3H)-Furanone, 5-methyl-
60	12.46	0.02	4-Cyclopentene-1,3-dione
61	12.49	0.02	Furan, 2-ethyl-
62	12.58	0.04	3-Penten-1-yne, (Z)-
63	12.69	0.14	Cyclopent-4-ene-1,3-dione
64	12.86	0.10	1-Nonene
65	12.96	0.15	1,3,5,7-Cyclooctatetraene
66	13.06	0.14	Pentanoic acid
67	13.14	0.04	Nonane
68	13.27	0.05	2-Formylhistamine
69	13.32	0.07	1,5-Heptadiene, 3,3-dimethyl-, (E)-
70	13.45	0.12	2-Cyclopenten-1-one, 2-methyl-
71	13.57	0.10	Ethanone, 1-(2-furanyl)-
72	13.70	0.33	2(5H)-Furanone

(Contd...)

Table 1: ***(Continued)***

No.	Retention Time (min)	Peak area (%)	Component
73	13.89	0.08	2-Cyclohexen-1-ol
74	13.95	0.11	4-[2-(5-Amino-2H-1,2,3,4-tetrazol-2-yl)ethoxy]-1,2,5-oxadiazol-3-amine
75	13.99	0.10	4-Pyranone, 2,3-dihydro-
76	14.10	0.59	2-Cyclopenten-1-one, 2-hydroxy-
77	14.34	0.02	2-Cyclohexen-1-one
78	14.37	0.04	Pyridine, 2,4-dimethyl-
79	14.51	0.09	2(5H)-Furanone, 5-methyl-
80	14.59	0.10	2,5-Furandione, dihydro-3-methylene-
81	14.78	0.07	2-Methylbut-2-en-1-yl acetate
82	14.86	0.03	1-Methylpyrazol-3-amine
83	15.00	0.04	Butanoic acid, 3-methyl-, butyl ester
84	15.09	0.06	7-Oxabicyclo[4.1.0]heptane, 1-methyl-
85	15.17	0.12	2-Butanone, 3,3-dimethyl-
86	15.27	0.55	Benzaldehyde
87	15.41	0.19	2-Cyclopenten-1-one, 3-methyl-
88	15.52	0.16	Pyridine, 3-ethenyl-
89	15.62	0.04	2H-Pyran-2-one
90	15.68	0.02	Acrylic acid, 3-amino-3-cyano-, methyl ester
91	15.79	0.15	4-Amino-2(1H)-pyridinone
92	15.84	0.39	Phenol
93	16.14	0.25	1-Decene
94	16.38	0.30	2H-Pyran-2,6(3H)-dione
95	16.50	0.42	2-Methyliminoperhydro-1,3-oxazine
96	16.56	0.09	Cyclopentanecarboxylic acid, 2-ethylcyclohexyl ester
97	16.73	0.05	2-Butanone, 4-hydroxy-3-methyl-
98	16.93	0.04	1H-Pyrrole-2-carboxaldehyde
99	16.99	0.02	Bicyclo[4.1.0]heptan-2-one, 6-methyl-
100	17.06	0.19	2-Cyclopenten-1-one, 2-hydroxy-3-methyl-
101	17.21	0.07	2-Butenedioic acid, 2-methyl-, (Z)-
102	17.36	0.01	Benzene, 1-ethyl-4-methyl-
103	17.43	0.02	Benzene, 2-propenyl-
104	17.53	0.45	2-Cyclopenten-1-one, 2-hydroxy-3-methyl-
105	17.65	0.02	Benzyl alcohol
106	17.72	0.02	Ethanone, 1-(2-methyl-1-cyclopenten-1-yl)-
107	17.89	0.23	Hydantoin, 5,5-dimethyl-2-thio-,
108	18.01	0.19	4-Methyl-5H-furan-2-one
109	18.21	0.40	1,3-Dioxol-2-one,4,5-dimethyl-
110	18.42	0.06	2-Cyclopenten-1-one, 2-hydroxy-3,4-dimethyl-
111	18.55	0.02	endo-Borneol
112	18.60	0.03	Ethanone, 1-(1H-pyrrol-2-yl)-
113	18.68	0.10	1-Nonene
114	18.77	0.06	Benzaldehyde, 2-methyl-
115	18.84	0.49	p-Cresol
116	18.99	0.20	2-Pentyne
117	19.12	0.27	Heptanoic acid
118	19.16	0.08	Heptanoic acid
119	19.29	0.20	2,5-Piperazinedione, 3-methyl-6-(1-methylethyl)-
120	19.39	1.06	Phenol, 2-methoxy-
121	19.52	0.14	Pyridine, 5-ethyl-2-methyl-
122	19.57	0.25	Carbamic acid, (2-hydroxy-1-methylethyl)-, 1,1-dimethylethyl ester, (s)-
123	19.74	0.14	2-Furanmethanol
124	19.98	0.06	Benzofuran, 2-methyl-
125	20.10	0.39	Maltol

(Contd...)

Table 1: ***(Continued)***

No.	Retention Time (min)	Peak area (%)	Component
126	20.19	0.12	2(1H)-Pyridinone
127	20.24	0.33	2-Cyclopenten-1-one, 3-ethyl-2-hydroxy-
128	20.34	0.06	trans-Sinapyl alcohol
129	20.39	0.10	2,5-Piperazinedione, 3-methyl-
130	20.58	0.28	trans-Sinapyl alcohol
131	20.72	0.16	Benzyl nitrile
132	20.79	0.15	trans-Sinapyl alcohol
133	20.86	0.11	Phenol, 2,3-dimethyl-
134	20.92	0.29	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-
135	21.00	0.24	2H-Pyran-2-one, tetrahydro-
136	21.06	0.16	2a,4a,6a,6b-Tetrahydrocyclopenta[cd]pentalene
137	21.11	0.10	trans-Sinapyl alcohol
138	21.20	0.48	1,3-Cyclopentanedione, 4-hydroxy-2-methyl-
139	21.29	0.21	Phenol, 3-ethyl-
140	21.35	0.35	Dehydromevalonic lactone
141	21.41	0.25	2-Cyclohexen-1-one, 4,4-dimethyl-
142	21.58	0.43	Octanoic acid
143	21.64	0.10	E-7-Tetradecenol
144	21.82	0.74	1,4,2,5 Cyclohexanetetrol
145	21.88	0.41	2-Vinyl-9-[.beta.-d-ribofuranosyl]hypoxanthine
146	21.91	0.30	Butanal, 3-hydroxy-
147	22.01	0.98	Creosol
148	22.12	1.08	Catechol
149	22.27	0.08	Ethanethioic acid, S-phenyl ester
150	22.31	0.08	6-Hydroxymethyl-5-methyl-bicyclo[3.1.0]hexan-2-one
151	22.46	0.35	Benzofuran, 2,3-dihydro-
152	22.53	0.09	Pyridine, 2,3-dimethyl-
153	22.67	0.21	Z-8-Methyl-9-tetradecenoic acid
154	22.78	0.62	5-Hydroxymethylfurfural
155	22.89	0.06	Methanol, (4-carboxymethoxy)benzoyl-
156	22.95	0.15	2-Coumaranone
157	23.04	0.09	4-Pentadecyne, 15-chloro-
158	23.11	0.08	3-Buten-2-ol, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-, (3E)-
159	23.16	0.09	2-Cyclohexen-1-one, 4-(1-methylethyl)-
160	23.28	0.14	Estra-1,3,5(10)-trien-17.beta.-ol
161	23.39	0.44	1,2-Benzenediol, 3-methyl-
162	23.51	0.51	1,2-Benzenediol, 3-methoxy-
163	23.56	0.43	2,2-Dimethyl-3-vinyl-bicyclo[2.2.1]heptane
164	23.71	0.07	Z-10-Pentadecen-1-ol
165	23.78	0.56	Phenol, 4-ethyl-2-methoxy-
166	23.85	0.20	1-Tridecene
167	23.97	0.79	1,2-Benzenediol, 4-methyl-
168	24.12	0.15	Indole
169	24.17	0.16	4,6-Dioxadodecane
170	24.24	0.09	Kessane
171	24.29	0.19	Oxaceprol
172	24.35	0.22	1,3-Dimethyl-4-(tetramethyl-1,3,2-dioxaborolan-2-yl) pyrazole
173	24.45	1.67	2-Methoxy-4-vinylphenol
174	24.57	0.31	2,3-Dioxabicyclo[2.2.2]oct-7-en-5-one, 1-(3-oxo-1-butenyl)-6,6,7-trimethyl
175	24.71	0.20	Acetamide, N-(4-fluorophenyl)-2-methoxy-
176	24.74	0.30	2(equat)-Methyl-trans-decahydroquinol-4-one
177	24.88	0.16	endo-1,5,6,7-Tetramethylbicyclo[3.2.0]hept-6-en-3-ol
178	24.97	0.27	Bicyclo[2.2.1]heptane-1-carbonyl chloride, 2-exo-chloro-
179	25.05	0.73	Phenol, 2,6-dimethoxy-

(Contd...)

Table 1: ***(Continued)***

No.	Retention Time (min)	Peak area (%)	Component
180	25.17	0.60	Eugenol
181	25.23	0.14	cis-11-Hexadecenal
182	25.27	0.20	Phenol, 3,4-dimethoxy-
183	25.33	0.34	Phenol, 2-methoxy-4-propyl-
184	25.43	0.28	1,2-15,16-Diepoxyhexadecane
185	25.57	0.58	1,3-Benzenediol, 4-ethyl-
186	25.66	0.27	Tetradecane
187	25.74	0.36	Indole, 3-methyl-
188	25.78	0.29	1,2,3-Benzenetriol
189	25.82	0.14	1,2,3-Benzenetriol
190	25.86	0.40	1,2,3-Benzenetriol
191	25.93	1.03	Vanillin
192	25.99	0.71	Phenol, 2-methoxy-4-(1-propenyl)-
193	26.10	0.18	1,2,4-Benzenetriol
194	26.16	0.39	2,3-Dioxabicyclo[2.2.2]oct-7-en-5-one, 1-(3-oxo-1-butenyl)-6,6,7-trimethyl
195	26.30	0.47	(2,4-Dioxo-1,3-dihydropyrimidin-5-yl)acetic acid
196	26.45	0.14	2,2,2-Trifluoro-N-[4-(2,2,2-trifluoro-acetylamino)-butyl]-acetamide
197	26.48	0.13	3,4-Dimethyl-o-phenylenediamine
198	26.57	0.63	3,5-Dimethoxy-4-hydroxytoluene
199	26.67	3.50	trans-Isoeugenol
200	26.73	0.35	E-9-Tetradecenoic acid
201	26.83	0.36	4-Methoxycinnamaldehyde
202	26.88	0.13	2-Cyano-2-[2-cyclopropyldiazen-1-yl]ethanethioamide
203	26.92	0.31	1-Pentadecene
204	26.98	0.33	Ethyl 9-heptadecenoate
205	27.07	0.50	1-Pentadecene
206	27.18	0.33	Pentadecane
207	27.29	0.68	Ethanone, 1-(3-hydroxy-4-methoxyphenyl)-
208	27.80	3.03	Beta.-D-Glucopyranose, 1,6-anhydro-
209	27.86	0.65	Beta.-D-Glucopyranose, 1,6-anhydro-
210	27.93	0.75	D-Allose
211	27.99	1.60	2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)-
212	28.10	0.31	Oxacyclotetradecane-2,11-dione, 13-methyl-
213	28.20	0.41	Dodecanoic acid
214	28.27	0.67	Nonanoic acid, 1-methylethyl ester
215	28.48	0.73	2,3,5,6-Tetrafluoroanisole
216	28.58	0.16	2-Dodecen-1-yl(-)succinic anhydride
217	28.64	0.23	Bicyclo(3.3.1)nonane-2,6-dione
218	28.70	0.48	Cyclotetradecane
219	28.81	0.23	Nonadecane, 9-methyl-
220	28.88	0.54	.alpha.-Amino-3'-hydroxy-4'-methoxyacetophenone
221	28.94	0.53	Butyrovanillone
222	29.12	0.55	Phenol, 2,6-dimethoxy-4-(2-propenyl)-
223	29.24	0.25	4-Propyl-1,1'-diphenyl
224	29.41	0.32	Estra-1,3,5(10)-trien-17.beta.-ol
225	29.47	0.17	n-PROPYL DECYL ETHER
226	29.54	0.26	Oxacyclotetradecan-2-one
227	29.66	0.26	2,2-Dimethyl-propyl S-benzene-thiosulfinate
228	29.74	0.28	9-Hexadecenoic acid
229	29.81	0.18	Imidazo[4,5-e]-1,4-diazepin-8-one, 1,4,5,6,7,8-hexahydro-1,4-dimethyl-
230	29.82	0.21	Palmitoleic acid
231	29.96	0.57	Tridecanoic acid
232	30.11	0.94	Benzenepropanol, 4-hydroxy-3-methoxy-

(Contd...)

Table 1: ***(Continued)***

No.	Retention Time (min)	Peak area (%)	Component
233	30.22	0.36	Z,E-2,13-Octadecadien-1-ol
234	30.33	0.56	Benzaldehyde, 4-hydroxy-3,5-dimethoxy-
235	30.46	0.28	Cyclopentadecanone, 2-hydroxy-
236	30.60	0.47	1-Heptadecene
237	30.74	0.25	9-Hexadecenoic acid
238	30.85	0.30	5-Amino-2-thiocyanoacetophenone
239	30.93	0.09	2H-1-Benzopyran-3-ol, 2-(3,4-dimethoxyphenyl)-3,4-dihydro-5,7-dimethoxy-, (2R-cis)-
240	31.01	0.22	3,9-Epoxytricyclo[4.2.1.1(2,5)]dec-7-en-10-ol, 9,10-dimethyl-
241	31.14	1.46	(E)-2,6-Dimethoxy-4-(prop-1-en-1-yl)phenol
242	31.46	0.19	Cyanoacetic acid, dodecyl ester
243	31.65	0.15	6H-1,2,5-Oxadiazolo[3,4-E]indole-6,8a-diol, 4,5,5a,7,8,8a-hexahydro-, 3-oxide
244	31.72	0.29	l-Norleucine, N-isobutoxycarbonyl-, heptadecyl ester
245	31.81	0.11	8',10'-Dioxaspiro[cyclopropane-1,5'-tricyclo[5.2.1.0{2,4}]decane]-6'-one
246	31.99	0.53	E-9-Tetradecenoic acid
247	32.16	0.58	Tetradecanoic acid
248	32.26	0.23	N-[p-Nitrobenzoyl]anthranilic acid
249	32.52	0.27	1,5-Dodecadiene
250	32.68	0.48	cis-1-Chloro-9-octadecene
251	32.89	0.43	2-Propanone, 1,1-diphenyl-
252	33.02	0.18	1-Nonadecene
253	33.19	0.42	13-Octadecenal, (Z)-
254	33.73	0.07	1-Octadecene
255	33.97	0.14	Methyl 13-methyl-icosanoate
256	34.17	0.11	9-Ethoxy-10-oxatricyclo[7.2.1.0(1,6)]dodecan-11-one
257	34.45	0.32	Ethanone, 1-(4-hydroxy-3,5-dimethoxyphenyl)-
258	34.63	0.28	13-Octadecenal, (Z)-
259	34.88	0.20	Cyclopentadecanone, 2-hydroxy-
260	35.12	0.62	Pentadecanoic acid
261	35.25	0.13	Octadecanoic acid
262	35.51	0.74	Octadecanoic acid
263	35.59	0.51	Octadecanoic acid
264	35.92	0.15	18-Nonadecenoic acid
265	36.24	0.23	1-Octadecene
266	36.47	0.15	Tricosane
267	36.78	0.17	1,1'-Biphenyl, 4-methyl-
268	37.31	0.09	7-Hexadecenoic acid, methyl ester, (Z)-
269	38.91	0.68	Hexadecenoic acid, Z-11-
270	39.05	0.21	Oxacycloheptadecan-2-one
271	39.23	0.99	n-Hexadecanoic acid
272	39.35	0.23	5-Undecene
273	39.85	0.06	9-Octadecenoic acid, (E)-
274	40.37	0.05	2-Dodecen-1-yl(-)succinic anhydride
275	40.39	0.03	Cyclopentadecanone, 2-hydroxy-
276	40.69	0.12	1-Docosene

et al., 2001; Bystrom et al., 2010). Phenol can denature proteins, so it has a bactericidal effect and shows strong antibacterial activity against many microorganisms, certain fungi, and viruses. Dilute solution phenol can be used as a disinfectant antiseptic and was used in surgery (Ogunrinola et al., 1996; Wang, 2007). According to statistics, in the 21st century, the demand for phenol in major regions such as the United States, Western Europe, and Japan maintained an average annual growth rate of 4.2%.

Maltol, is a white to slightly yellow needle crystal or crystalline powder, with a special aroma of coke cream, and a dilute solution with a strawberry flavor. It is mainly used in the food industry to formulate strawberry, coffee,

malt, nuts, herbs and various fruit flavors. Maltol is also an excellent material for the smooth coating of photographic film to prevent spots and streaks. The skin care cosmetics formulated therewith have the effect of inhibiting melanin growth and whitening the skin (Thompson et al., 2006; Ferreira et al., 2003; Ni et al., 2005; Yasumoto et al., 2004; Singh et al., 2007; Zhang et al., 2000; Liu, 2017; Kmita et al., 2018; Hoque et al., 2018; Khan et al., 2018; Cui et al., 2018).

CONCLUSION

From the above studies, it can be seen that the TGA-DTG analysis showed that the weight loss process of cornus officinalis bark was divided into three stages. The first stage is 20-80°C. The reason for the decline in this part of the curve is that the water molecules contained in the leaves and small molecules with relatively low boiling points evaporate as the temperature rises; the second stage is 80-200°C, during which some organic molecules begin to decompose, and the mass ratio is from 93% decline to 90%; final stage at 200-300°C. At this stage, as the temperature continues to rise, the organic components of the component undergo severe cracking decomposition and combustion of other components, the mass ratio drops from 90% to the final 74%, and the mass loss is T16wt%.

In the PY-GC-MS test, 276 peaks were detected in the bark of cornus officinalis and 276 chemical components were identified. The identified compounds can be classified into esters, acids, phenols, tannins, iridoids, soaps, ketones, and glycosides. Among them, Furfural is not only an important organic material in medicine and industry, but also can be used as a solvent to selectively extract unsaturated components from petroleum and vegetable oils. As an important chemical material, phenol can denature protein to make it have a certain bactericidal effect. Maltol is widely used in a variety of fruit flavors in the food industry due to its unique creamy flavor characteristics. At the same time, it also has a good effect of inhibiting melanin growth and whitening the skin.

Through the research and analysis of the volatiles of cornus officinalis bark, we can clearly understand the organic substances it contains, provide reference for the development of medical or industrial food, and provide fuller and more extensive value for cornus officinalis bark, and provides better help.

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