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LETTER TO THE EDITOR

Nanocatalysis Regulates Bioactive Component Diversity of 550°C Pyrolyzates from Barks of Cinnamomum camphora in North China

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Cinnamomum camphor has been introduced into North China as a greening tree for beautiful China project. However, the value of *C. camphor* bark has not been revealed and hence was abandoned directly, causing great waste of resources and environmental pollution. Therefore, the components of pyrolyzates from bark of *C. camphor* in North China were regulated by nanocatalysis with different catalysts. The powder of *C. camphor* bark and the powders treated with nanocatalysts (Ag, NiO, 1/2Ag+1/2NiO) were pyrolyzed at 550°C. The original powder pyrolyzate and three nano-catalyzed pyrolyzates are abundant in bioactive components of bioenergy, biomedicine, food additive and spices; however, nano-Ag and nano-NiO catalyses increse the content of biomedicine components, nano-NiO catalysis increases the content of cosmetics components. These findings here suggested that *C. camphor* bark has a potential of biomedicine and cosmetics utilization by special nanocatalysis.

I Introduction

Cinnamomum camphor belongs to the genus *Morus* of the *Lauraceae* family. *C. camphor* is evergreen trees of subtropical zone. It is a fine tree species for urban greening (Bhau et al. 2018) widely used as shade tree, sidewalk tree, shelter forest and scenic forest (Azab et al. 2017). The leaves, branches, roots, stems, flowers and fruits of *C. camphor* are rich in aromatic oil, which is an excellent tree species for extracting natural spices (Guo et al. 2017). Camphor and camphor oil can be extracted from roots (He et al. 2017), wood, branches and leaves of *C. camphor*. The main components of camphor oil are pine oil, bicyclic hydrocarbon (Chen and Dai 2012), camphene, lemonene and so on. Camphor can be used in medicine, plastics, explosives, antisepsis, insecticide and so on (Liu et al. 2017). Camphor oil can be used as pesticide, soap, paint and essence. Studies have proved that camphor seed has the effects of dispelling cold and removing dampness (Listewnik et al. 2018), relieving pain, treating vomiting and diarrhea, stomach cold (Azab et al. 2017), abdominal pain, diarrheac (Brooms et al. 2018), beriberi, swelling and toxicity, lowering blood lipid (Chang et al. 2017). Band lowering cholestero. Recent studies have found that camphor, 1,8-cineole and a small amount of alpha-terpineol (Bueno-Hernández et al. 2017), beta-pinene, alpha-pinene, geranial, alpha-phellandrene, camphene, borneol are the main components of camphor leaves. Some of these substances, such as orangal aldehyde, have been exploited in many ways. Because *C. camphor* has high medicinal value and ecological value, the planting area of *C. camphor* has been expanding.

People have always studied and paid attention to the leaves, branches, roots, stems, flowers and fruits of *C. camphor*. However, the development of *C. camphor* bark resources is not clear, resulting in a great waste of resources and ecological environment pollution (Roy et al. 2018, Yu et al. 2018). In order to reverse this situation, improve the resource utilization of *C. camphor* bark. We use modern analytical techniques to analyze the components of *C. camphor* bark, so as to put forward reasonable suggestions to further tap its potential economic value and development ways (Ennaji et al. 2018).

II Materials and Methods

(1) Experimental Materials

The *C. camphor* bark powder was sieved out into a 200 mesh powder. Then prepare four samples, each taking 2g weight. The parts were recorded as B1, B2, B3, and B4. B1 consisted of the original *C. camphor* bark powder without catalyst; B2 and B3 consisted of the *C. camphor* bark powder with the catalyst 0.02 g nano- Ag and 0.02 g nano-NiO, respectively; and 1/2Ag+1/2NiO consisted of the *C. camphor* bark powder with the mixed catalyst 0.01 g nano-NiO and 0.01 g nano-Ag.

(2) Methods

Differential scanning calorimetry–thermogravimetric analysis. Detection was conducted using 10 mg samples placed in instrument. The temperature program of TG started at 30°C, and reached 850°C at 10 °C/min. The carrier gas is high purity nitrogen (Lam et al. 2019).

Pyrolysis–gas chromatography/mass spectrometry. Py–GC/MS determination: The *C. camphor* barks were powdered by thermal cracking–gas chromatography–mass spectrometry (CDS6250T-Agilent7890-5977). GC was conducted under the following conditions: quartz capillary column. 30 mm × 0.25 mm × 0.25 μm; helium as the carrier gas; carrier gas flow velocity, 1.0 mL/min; inlet temperature, 280ºC, split ratio, 5:1. Heating procedure: The GC program started at 50ºC for 2 min, and rose to 300ºC at 10 ºC/min for 10 min. MS was conducted under the following conditions: ionization mode, EI, electron energy, 70 Ev.

III Results

Pyrolysis characteristics of *C. camphor* branches during heating

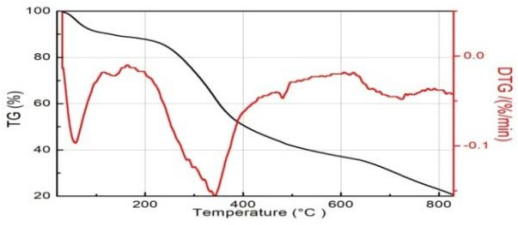

Fig. 1. Weightlessness curve of C. camphor bark

The TG curve declines continuously and the sample quality being lost continuously (Fig. 1). The total weight loss of the sample was about 80%, ranging from 30°C to 850°C. At 55°C, the DTG curve has a corresponding weightlessness peak with mass loss of about 3.18%, which may be attributed to the evaporation of moisture from the sample. At 340°C, The DTG curve has a corresponding weightlessness peak with mass loss of about 47.77%, which may be related to the partial decomposition of the sample.

Diverse bioenergy and bioactive components of nano-catalyzed 550°C pyrolyzates from *C. camphor* bark

At 550°C, the original powder pyrolysis products of *C. camphor* bark. Some bioenergy components were found in the *C. camphor* original powder. Pyridine, pyridine, 2-methyl- are flammable liquids. Some substances explode

when they mix with air (Liu et al. 2017). Some components found in the *C. camphor* original powder can be used in biomedicine. For example, metaraminol is an adrenaline-like drug used in acute hypotension, and is one of the commonly used drugs in the treatment of patients with physical distress (Chen and Dai 2015). The raw *C. camphor* powder contained a large amount of spices constituents and food additives. Eucalyptol is a food spices. It is mainly used in cough sugar, artificial mint, etc. It is also one of the inherent ingredients of lavender oil and ear lavender oil. Phenol, 2-methoxy- can be used as food spices (Chen and Dai 2012).

The *C. camphor* barks original powder with the catalyst B2 in pyrolysis products Some bioenergy constituents were detected in the *C. camphor* bark original powder with the catalyst B2. For example, phenol, eucalyptol, phenol, 3-methyl-, mequinol, catechol, eicosane, and docosanoic acid is flammable substances (Liu et al. 2018). Large quantities of biomedicine constituents were detected in the *C. camphor* bark original powder with the catalyst B2. Catechol is an important pharmaceutical intermediate, which can be used to manufacture cough-killer, eugenol, berberine and isoproterenol. Stigmasterol is the raw material of steroid hormone synthesis, and also the raw material for producing vitamin D3.Some constituents were identified as rich perfume, such as spicesotic and food additives in the C. camphor bark original powder with the catalyst B2. Maltol is a broadening aroma synergist, which has the effect of enhancing aroma, sweetening. It can be used to make food flavors, tobacco flavors, cosmetic flavors, etc.

The *C. camphor* barks original powder with the catalyst B3 in pyrolysis products. Several bioenergy constituents in the *C. camphor* bark original powder with the catalyst B3 were identified. For example, P-Cresol and 1, 4-Pentadiene can be flammable when exposed to fire, high temperature and strong oxidant. Toluene can be used to produce explosives. Some components found the C. camphor bark original powder with the catalyst B3 can be used in biomedicine. Squalene can be used as a nutritional supplement to improve liver function and tissue activity. In order to prevent oxidation, it is usually used in conjunction with vitamin E. Octacosanol as a health food is mainly to enhance physical strength and endurance (Kurzbaum et al. 2017); reduce cholesterol, inhibit lipid peroxidation; anti-thrombosis and anti-ischemia, improve myocardial function. Many aroma constituents can be used as spices or food additives. Such as, Vanillin is an edible flavoring agent with vanilla bean aroma and strong milk aroma. It is an indispensable raw material in the food additive industry. Vanillin is widely used in various flavoring foods which need to increase milk aroma, such as cakes, cold drinks, chocolate, candy, biscuits, instant noodles, bread and tobacco, flavoring liquor, etc.

The *C. camphor* bark original powder with the catalyst 1/2Ag+1/2NiO in pyrolysis products .Some bioenergy constituents were found in the *C. camphor* bark original powder with the catalyst B4.2-Propanone,1-hydroxy-, Pyridine,1,4-Pentadiene, Phenol, etc. Their flammability determines their potential as bioenergy (Cheng et al. 2018).

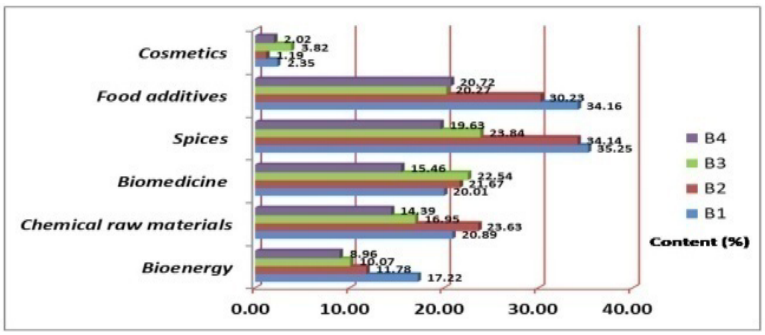

Fig. 2. comparison of functional classification relative contents of B1, B2, B3 and 1/2Ag+1/2NiO

As shown in Fig. 2: at 550°C, the relative content of bioenergy products, spices and food additives in B1

pyrolysis products are high. The relative content of biomedicine and cosmetics in B3 pyrolysis products are high. The relative content of Chemical raw materials in B2 pyrolysis products is high.

IV Conclusion

The pyrolysis products include bioenergy components, biomedicine components, food additives, spices, and chemical raw materials at 550°C. At 550°C, the relative content of bioenergy products, spices and food additives in B1 pyrolysis products are high. The relative content of biomedicine and cosmetics in B3 pyrolysis products are high. The relative content of Chemical raw materials in Ag pyrolysis products is high.

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