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RESEARCH ARTICLE

Production of Lemongrass (*Cymbopogon Citratus*) Powder

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Abstract

Lemongrass (*Cymbopogon citratus*) is a perennial grass belonging to genus *Cymbopogon*. The lemongrass has a very wide demand in nutritional, medicinal and flavoring industry. *Cymbopogon citratus* contains various phytoconstituents such as flavonoids and phenolic compounds, terpenoids and essential oils, which may be responsible for the different biological activities. The demand for lemongrass (*Cymbopogon citratus*) is for its high citral content. But it is not stored as fresh for long time at ambient condition because it turns brown and rotten quickly. Even processing or preservation, its volatility and susceptibility to degradation are the major drawbacks for the use of *Cymbopogon citratus* oil. This research studied the feasibility of lemongrass dried powder production by treatment of vapor steaming (140°C in 10s; 130°C in 15s, 120°C in 20s, 110°C in 25s), drying temperature (40°C, 45°C, 50°C, 55°C) in 6 hours to 6.5% moisture content, grinding and coating materials (ß-cyclodextrin, sodium alginate, carrageenan, cacboxymethyl cellulose) in different concentration (1.0%, 1.5%, 2.0%, 2.5%). The total chlorophyll content (mg/100g), citral content (%) were estimated. Results revealed that vapor steaming at 130°C in 15s, drying at 50°C in 6 hours to 6.5% moisture content, grinding and coating with 2.0% of ß-cyclodextrin were appropriated for lemongrass dried powder production.

Keywords: *Lemongrass, Dried powder, Chlorophyll, Citral, β-cyclodextrin, Sodium alginate, Carrageenan, Cacboxymethyl cellulose*

Introduction

Lemongrass is a perennial grass plant widely distributed worldwide and most especially in tropical and subtropical countries [1]. Lemongrass is equally versatile in the garden. This tropical grass grows in dense clumps with a short rhizome. When squeezed, the leaves usually produce yellow or amber colored, aromatic, essential oil [2]. Its aqueous extract is commonly used as an aromatic drink while the whole plant is well incorporated into traditional food for its lemon flavour. It also enjoyed wide application in folk medicine [3].

Tea made from lemongrass leaves is popular among countries having been widely utilized as antiseptic, anti fever, anti dyspeptic, and carminative and anti-inflammatory effects. Lemongrass tea contains several biocompounds in its decoction, infusion and essential oil extracts. Anti-oxidant, anti-inflammatory, anti-bacterial, anti-obesity, antinociceptive, anxiolytic and antihypertensive evidences of lemongrass tea were clearly elucidated to support initial pharmacological claims [4].

Lemongrass contains several important bioactive compounds which are useful in several health issues. These active compounds are normally found in the leaves. Essential oils from these species are widely used in flavours, fragrances, cosmetics, soaps, detergents and perfumery owing to their typical lemon and rose-like aroma. The essential oils of *Cymbopogon* species mainly consist of the monoterpene fractions. The compounds identified in *Cymbopogon citratus* are mainly terpenes, alcohols, ketones, aldehyde and esters.

Some of the reported phytoconstituents are essential oils that contain Citral α, Citral ß, Nerol Geraniol, Citronellal, Terpinolene, Geranyl acetate, Myrecene and Terpinol Methylheptenone. The plant also contains reported phytoconstituents such as flavonoids and phenolic compounds, which consist of luteolin, isoorientin 2'-O-rhamnoside, quercetin, kaempferol and apiginin [5]. *Cymbopogon* essential oils and constituents present therein e.g. citral,

geraniol, citronellol, citronellal and piperitone, have been known to possess impressive antibacterial, antifungal, antiyeast, insecticidal and insect repellent activities for a long time [6]. The essential oils in *Cymbopogon* species are biosynthesized in the rapidly growing leaves and stored in specific oil cells in the parenchymal tissues [7, 8].

Early or delayed harvesting of lemongrass affected essential oil and citral content [9]. Chlorophyll is a green photosynthetic pigment which helps plants to get energy from light. The chlorophyll contents were helps to add green colour in final products and also acts as a phytochemical to treat against cardiovascular disease, cancer, skin disease and improves liver detoxification. The primary reason to consider chlorophyll is a super food due to its strong antioxidant and anticancer effects.

Chlorophyll a is bluish-green while chlorophyll b is yellow green colour pigments [10]. Lemongrass contains mainly citral [11] and 1 to 2% essential oil on a dry basis [12]. Essential oil and citral of lemongrass were detected to gather at parenchyma tissue cells, specifically in the adaxial surface of leaf mesophyll [7]. Citral of lemongrass is a natural combination of two isomeric aldehydes, namely isomers geranial (α-citral) and neral (ß-citral).

Other unusual active components are limonene, citronellal, ß-myrcene and geraniol [11]. There were several researches mentioned to the processing methods of lemongrass (*Cymbopogon citratus*). A study developed to characterize microparticles containing this oil viewing the stabilization of lemongrass volatile oil [13].

Lemongrass (*Cymbopogon citratus*) essential oil was affected by drying methods [14]. A preparation and preservation of lemongrass (*Cymbopogon flexuosus* (Steud) Wats) powder for tea was studied [15]. Effect of drying on quality and sensory attributes of lemongrass (*Cymbopogon citratus*) tea was observed [16].The aim of this work was to study the feasibility of lemongrass dried powder production by the effect of treatment of vapor steaming, drying temperature, coating material to the total chlorophyll and citral content.

Material and Method

Material

Lemongrass (*Cymbopogon citratus*) was collected from Can Tho province, Vietnam. ß-cyclodextrin, sodium alginate, carrageenan, cacboxymethyl cellulose were purchased from Fluka® (USA). All other chemicals were of analytical grade.

Figure 1: Lemongrass (*Cymbopogon citratus*)

Researching Method

Effect of Steaming Temperature and Time to Total Chlorophyl (mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Raw lemongrass was steamed by vapor in different temperature and time (140°C in 10s; 130°C in 15s, 120°C in 20s, 110°C in 25s). Then it was dried under 40°C in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with 0.1% cacboxymethyl cellulose. The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal steaming condition.

Effect of Drying Temperature to Total Chlorophyl (mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Raw lemongrass was steamed by vapor at 130°C in 15s. Then it was dried under different temperature (40°C, 45°C, 50°C, 55°C) in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with 0.1% cacboxymethyl cellulose. The total chlorophyll content (mg/100g),

citral content (%) were estimated to demonstrate the optimal drying temperature condition.

Effect of Coating Material to Total Chlorophyl (mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Raw lemongrass was steamed by vapor at 130°C in 15s. Then it was dried 50°C in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with coating materials (ß-cyclodextrin, sodium alginate, carrageenan, cacboxymethyl cellulose) in the same concentration 1.0%. The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal coating material.

Effect of Coating Concentration Total Chlorophyl (mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Raw lemongrass was steamed by vapor at 130°C in 15s. Then it was dried 50°C in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with coating materials ß-cyclodextrin in different concentration (1.0%, 1.5%, 2.0%, and 2.5%). The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal coating concentration.

Total chlorophyl (mg/100g) and Citral Content (%) Determination

1g of powder sample was weighed and added with 5 ml distilled water. The mixtures were transferred to a centrifuge tube and the total volume was made up to 10 ml with distilled water. 0.5 ml from the tube was transferred to a tube containing 4.5 ml of 80% acetone. The contents were centrifuged at 4000 rpm for 15 min. The absorbance of the supernatant was measured at the following wavelengths 645 and 663 nm [17]. The optical density was measured and the chlorophyll contents in the original extract was estimated using the formula given by Talreja [18]. Total chlorophyll (mg/L) = 20.20 A645 + 08.02 A663. Citral content (%) was analyzed by GC-MS.

Statistical Analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Effect of Steaming Temperature and Time to Total Chlorophyl (mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Raw lemongrass was steamed by vapor in different temperature and time (140°C in 10s; 130°C in 15s, 120°C in 20s, 110°C in 25s). Then it was dried under 40°C in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with 0.1% cacboxymethyl cellulose. The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal steaming condition.

Table 1: Effect of steaming temperature and time to total chlorophyl (mg/100g) and citral content (%) in the dried lemongrass powder

Steaming temperature and time	Total chlorophyl (mg/100g)	Citral content (%)
140°C in 10s	98.43±0.12^{b}	68.19±0.03^{b}
130°C in 15s	107.38±0.09^{a}	72.43±0.06^{a}
120°C in 20s	94.12±0.13^{c}	65.21±0.04^{c}
110°C in 25s	87.35±0.10^{d}	60.37±0.03^{d}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

According to Niar [19] the lemongrass essential oil is usually made up of citral at an average of 65 to 80%. Citral is a combination compound of bioactive isomers geranial and neral. The effect of traditional (shade and sun) and cabinet drying on chlorophyll content and colour values of fresh lemongrass leaves and its powder were estimated. The fresh lemongrass had 1.7258 mg/g, while shade, sun and cabinet dried lemongrass powder had 0.1994, 0.1567 and 0.1338 mg/g total chlorophyll content [10].

Effect of Drying Temperature to Total Chlorophyl (Mg/100g) and Citral

Content (%) in the Dried Lemongrass Powder

The demand for high-quality dried food products is permanently increasing all over the world.

The main purpose of drying is to extend product shelf life, minimize packaging requirements and reduce shipping weights [20]. Drying process increases the shelf life by slowing microbial growth and thus preventing certain biochemical reactions that might alter the organoleptic characteristics [21, 20]. Raw lemongrass was steamed by vapor at 130°C in 15s. Then it was dried under different temperature (40°C, 45°C, 50°C, 55°C) in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with 0.1% cacboxymethyl cellulose. The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal drying temperature condition.

Table 2: Effect of drying temperature to total chlorophyl (mg/100g) and citral content (%) in the dried lemongrass powder

Drying temperature (°C)	Total chlorophyl (mg/100g)	Citral content (%)
40	107.38±0.09^{b}	72.43±0.06^{b}
45	112.04±0.04^{ab}	73.68±0.03^{ab}
50	118.45±0.07^{a}	74.13±0.04^{a}
55	118.51±0.13^{a}	74.17±0.02^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Lemongrass (*Cymbopogon citratus*) essential oil was affected by drying methods. The leaves of lemongrass (*Cymbopogon citratus*) were dried using three different drying methods (sun-drying for 36 h, shade-drying for 48 h and oven-drying at 45 °C for 7 h). The essential oil was obtained by hydro-distillation of the leaves dried by every treatment, and was analyzed by capillary GC and GC/mass instruments.

Statistical analysis showed significant differences in the essential oil content of leaves dried by different drying methods. Oven drying gave the highest essential oil percentage (2.45%) compared to shade-drying (2.12%) and sun-drying methods (2.10%). Eighteen components were identified in the essential oil of fresh and dried *C. citratus* leaves obtained by different drying methods, including geranial (citral-a), neral (citral-b) and myrcene as main components. [14].

In another research, the effect of drying on proximate and phytochemical composition was determined. The phytochemical constituents get reduced when subjected to cabinet drying [22]. One study investigated the effect of drying on quality and sensory attributes of lemon grass (*Cymbopogon citratus*) tea. Lemongrass (*C. citratus*) leaves were dried using four different drying methods: sun, solar, oven (40, 50, and 60°C), and microwave. Results indicate that drying temperature and time are the main factors affecting the colour of dried lemongrass leaves for tea. There was a significant difference ($p < 0.05$) in the colour profile of the dried leaves. The study revealed that oven drying at 40°C for 15 hours was found to be most suitable for drying of lemongrass leaves for tea production in order to retain appreciable sensory attributes (50 W) [16].

Effect of Coating Material to Total Chlorophyl (Mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Different materials are used for the encapsulation of monoterpenes, including arabic gum [23] and mesquite gum [24], which are commonly used as a food flavor encapsulants, proteins (sodium caseinate, soy protein isolate) [25], colloidal silicon dioxide [26], gelatins [27], maltodextrin [28] and cyclodextrin [29]. Even processing or preservation, its volatility and susceptibility to degradation are the major drawbacks for the use of *Cymbopogon citratus* oil.

It's essential to include lemongrass oil into microencapsulation. Raw lemongrass was steamed by vapor at 130°C in 15s. Then it was dried 50°C in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with coating materials (ß-cyclodextrin, sodium alginate,

carrageenan, cacboxymethyl cellulose) in the same concentration 1.0%. The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal coating material.

Table 3: Effect of coating material to total chlorophyl (mg/100g) and citral content (%) in the dried lemongrass powder

Coating material at 1.0%	Total chlorophyl (mg/100g)	Citral content (%)
β-cyclodextrin	132.75±0.05[a]	87.23±0.05[a]
Sodium alginate	94.68±0.09[c]	69.82±0.01[c]
Carrageenan	89.74±0.03[d]	63.40±0.02[d]
Cacboxymethyl cellulose	118.45±0.07[b]	74.13±0.04[b]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

A study developed to characterize microparticles containing this oil viewing the stabilization of lemongrass volatile oil. Two techniques of preparation were evaluated; spray drying and precipitation, and two encapsulation materials, ß-cyclodextrin (ß-CD) and hydroxypropyl-ß-cyclodextrin (HP-ß-CD) were tested. The results showed that the use of the ß-CD as encapsulant material was more efficient [13].

Effect of Coating Concentration to Total Chlorophyl (mg/100g) and Citral Content (%) in the Dried Lemongrass Powder

Among the polymeric materials with efficient protection of volatile oils and monoterpenes, the cyclodextrins are extensively studied, and -cyclodextrin is most widely used in the microencapsulation of substances[29, 32]. Cyclodextrins (α, ß or γ, as well as their commercially available derivatives) are well known for their ability to include apolar molecules or parts of molecules inside their hydrophobic cavity. Raw lemongrass was steamed by vapor at 130°C in 15s.

Then it was dried 50°C in 6 hours to 6.5% moisture content. After that, the dried lemongrass would then be ground into powder. This powder would be coated with coating materials ß-cyclodextrin in different concentration (1.0%, 1.5%, 2.0%, 2.5%). The total chlorophyll content (mg/100g), citral content (%) were estimated to demonstrate the optimal coating concentration.

Table 4: Effect of β-cyclodextrin coating concentration to total chlorophyl (mg/100g) and citral content (%) in the dried lemongrass powder

β-cyclodextrin concentration (%)	Total chlorophyl (mg/100g)	Citral content (%)
1.0	132.75±0.05[b]	87.23±0.05[b]
1.5	137.12±0.03[ab]	89.55±0.00[ab]
2.0	140.45±0.07[a]	92.48±0.04[a]
2.5	140.52±0.01[a]	92.53±0.02[a]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

In one research, leaves of lemongrass at full maturity stage (whole and cut into 5 cm pieces) were blanched at 80°c for 1 min, dried, ground into fine powder and analyzed for chemical constituents.

The lemongrass leaves of all varieties contained essential oil (1.20 to 4.40%), ascorbic acid (1.75 to 1.89 mg/100g) and total chlorophyll (7.49 to 10.76 mg/g) with reasonably good amount of ash (3.0 to 7.00%) on dry weight basis. During storage for 6 months, the essential oil ascorbic acid and total chlorophyll content were significantly decreased while ash content significantly increased [15].

Conclusion

Cymbopogon citratus, Stapf (Lemon grass) is a widely used herb in tropical countries, especially in Vietnam. The essential oil of the plant is used in aromatherapy. The compounds identified in *Cymbopogon citratus* are mainly terpenes, alcohols, ketones, aldehyde and esters.

Various pharmacological activities such as anti-amoebic, antibacterial, anti-diarrheal, anti-filarial, antifungal and anti-inflammatory properties have been indicated. *Cymbopogon citratus*, Stapf (Lemon grass) is commonly used in teas, soups and curries. It is also suitable for poultry, fish and seafood. Lemongrass powder is preferred and it has huge demand in the world market.

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