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A COMPARATIVE STUDY ON PHENOLIC AND ESSENTIAL OIL PROFILES OF GINGER AND GREEN TEA

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ABSTRACT: *The chemical compositions of ginger rhizomes and green tea leaves were as follows (17.72 ,13.72%) crude protein , (4.81 , 7.3%) total lipids, (57.6 , 68.18%), total carbohydrate and (510 , 376 mg/100 g dw) total phenols respectively .*
The predominant phenols were: Quercetin (21.41%) , Gingerols (18.70%), Zingerone (17.77%) , salicylic acid (12.07%) , Rutin (8.70%) and catechin (8.06%) for ginger rhizomes. While for green tea leaves they were quercetin (26.76%) , catechin (22.31%), salicylic acid (13.32%) , Rutin (9.7%) , Gallic acid (8.35%) and phenol (5.57%)
The essential oil from ginger rhizomes has been studied and was characterized by its high content of α-zingibernene (23.64%) and Geraniol (11.62 %).
Whereas essential oil from the green tea leaves contained (37.83%) 1,8-cineole , (20.58%) Terpinen – 4 – ol , (12.39%) γ-terpinene and (11.29%) camphene .

Key words: *Phenolic and essential oil.*

INTRODUCTION

Surh *et al.,* (1999) found that ginger rhizomes contains pungent phenolic substances and aromatic ketones collectively as gingerones , which are thougt to be the most pharmacologically active components One of the major pungent principles of ginger is (6) – gingerol , which has diverse effect including antioxidant and anti-inflammatory activities .

Shivanand *et al.,* (2004) found that three gingerols (6,8 and 10 gingerols) and (6) – shogaolwere found in the extracts of white and yellow gingers , the most abundant constituent among them was 6 – gingerol , representing nearly 34% and 28% in yellow and white varieties respectively , followed by [10] and [8] – gingerols . The presence of [6] shogaol at a major level of 0.35% was identified in both two varieties.

Martins *et al.,* (2001) found that essential oil of ginger contains 1,8 –cineole (25.5-34.4%) , p-pinene (14.-15.2 %) and alpha - terpineol (9.9-12.1%). Mitsuo and Hiriomeu (1988) isolated seventy two components identified in the volatile oil of ginger including 15 monoterpene Hydrocarbons , 13 sesquiterpene hydrocarbons , 11monoterpene alcohols , 11sesquiterpene alcohols , 5 monoterpene aldehydes and ketones , 1 acid , 4 esters , 2 phenolic compunds and 11 miscellaneous components . 34 of these components were newly found as the odor components of ginger among them alpha - zinigberene was the main component (21.8%), while the others was as follows 1 , 8-cineole (6.2%) , Nerol (7.1%) and geraniol (9.4%) . Geranial, alpha -terpineol , Berneol and B. bisabolene amounts were 9.9 , 5.6 , 5.4 and 7.9% respectively.

Fumiyui *et al.,* (1992) found that [6]-gingerol has been identified as the main constituent responsible for the pungent taste of ginger

Ninomiya *et al.,* (2012) recorded that the main components of tea tree oil was terpinen – 4 – ol

Chabir *et al.,* (2011) identified thirty two components representing more than 98% of the total compositions of essential oil extracted from leaves of green tea. The main-components were 1 , 8-cineole (85%) , camphene (5.05%) and alpha -pinene (1.95%) .

Rudback *et al.,* (2012) cleared that the monoterpenealpha -terpinene is one of the components responsible for the antioxidant activity of tea tree oil .

They added that autoxidation of alpha - terpinene at room temperature produced allylic epoxides and p-cymene as the major oxidation products.

Emira *et al.,* (2011) found that tea tree essential oil rich in terpinen – 4 – ol (40.44%), , gamma -terpinene (19.54%) , 1 , 8-cineole (35.61%) and alpha -pinene (1.5%) .

MATERIALS AND METHODS

The rhizomes of ginger (*Zingiberofficinale*) were purchased from local market . The leaves of tea tree (*Melaleucaalternifolia*) were obtained from the trees growing in Giza Zoo-Egypt .

The two samples were identified by horticulture Dep. Fac. of Agric. Minufiya Univ.

Preparation of samples

Samples of ginger rhizomes and green tea leaves were cut and dried.

Chemical analysis

- Crude protein , total lipids , carbohydrates , crude fiber and ash were determined according to the method described by A.O.A.C. (2000)
- HPLC analysis of phenolic compounds were performed according to the method describe by Duke *et al.,* (2003)
- The essential oils of the two samples were extracted by water distillation and identified using gas chromatography/massspectrometry (GC/MS) according to the method described by Guenther (1960).

RESULTS AND DISCUSSION

The data presented in Table (1) and Fig. (1) showed that ginger rhizomes contain 17.72 , 4.81 , 57.60 , 0.58 and 0.31% crude protein , total lipids , total carbohydrates , crude fiber and ash respectively .

While the amounts for the same constituents in green tea leaves were 13.72, 7.3 , 68.18 , 2.83 and 0.82% respectively.

The results presented in Table (2) revealed that ginger rhizomes contain higher amount of total phenols (510mg/100g) than that in green tea leaves (376mg/100g), these results are in agreement with those of Surh *et al.,* (1999) and Emira *et al.,* (2011).

Hplc-for polyphenols

Table (3) and Fig. (2) showed the presence of 16 compounds in ginger rhizomes. The phenolic compounds quercetin (21.41%) , gingerols (18.7%) , zingerone (17.77%) and salicylic acid (12.07%) were the predominant phenols , while rutin (8.7%) , catechin (8.06%) , cinnamic acid (3.06%) gallic acid (3.00%) and phenol (2.95%) were found in moderate amounts . On the other hand phenols naringinin (1.20%) , kaempferol (1.08%) , shogaols (1.06%) , paradol (0.29%) , p-coumaric(0.29%) , daidzin (0.27%) and chrysin (0.10%) were presented in minor amounts in ginger rhizomes . These results are in agreement with those obtained by Shivanand *et al* (2004) and khadem *et al* (2008) who reported that ginger phenols were gingerol and zingerone .

Data in Table (3) and Fig. (2) demonstrate that green tea leaves contain 15 components of phenols , three of them are predominant ones , quercetin (26.76%) , catechin (22.31%) and salicylic acid (13.32%) , while four phenols were detected in moderate amount rutin (9.7%) , gallic acid (8.35%) , phenol (5.57%) and cinnamic acid (4.53%) .On the other hand phenols naringenin (2.31%) , kaempferol (1.79%) , luteolin (1.19%) , synergic acid (1.71%) , chrsyin (0.16%) , daidzin (0.95%) ferulic acid (0.95%) and galangin (0.4%) were found as minor phenols of green tea leaves .Our results are in agreement with those of Galati *et al.,* (2006) who demonstrated that tea phenolic acids and catechins containing gallic acid moieties are most abundant in green tea .

Table (1): Chemical composition of the green tea leaves and ginger rhizomes (%).

Constituents	Ginger rhizomes	Green tea leaves
Moisture	8.00	6.82
Crude protein	17.72	13.72
Crude Lipid	4.81	7.3
Total Carbohydrate	57.60	68.18
Crude Fiber	0.58	2.83
Ash	0.31	0.82

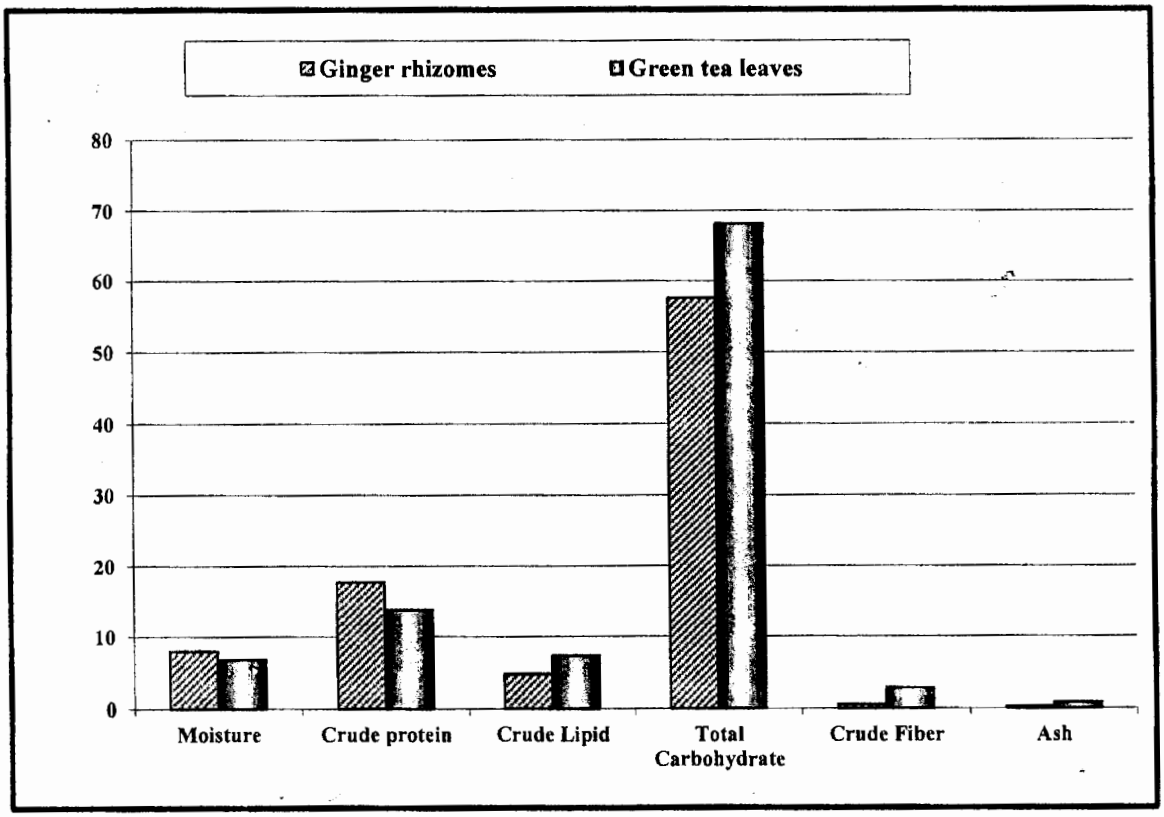

Fig. (1): Chemical composition of the green tea leaves and singer rhizomes.

Table (2): Total phenols content of ginger rhyzomes and green tea leaves:(mg/100g d.w.)

Samples	Total phenols mg/100g d.w.
Ginger rhizomes	510
Green tea leaves	376

Table (3): HPLC analysis of polyphenols for ginger rhizomes and green tea leaves (mg/100g dry weight).

Phenolic compounds	Ginger rhizomes		Green tea leaves	
		%		%
Gallic acid	12.2	3.00	21.0	8.35
Catechin	32.8	8.06	56.1	22.31
Shogaols	4.3	1.06	—	—
Zingerone	72.3	17.77	—	—
Phenol	12.0	2.95	14.0	5.57
daidzin	1.1	0.27	2.4	0.95
Synergic acid	—	—	4.3	1.71
Rutin	35.4	8.70	24.4	9.70
P – coumaric	1.2	0.29	—	—
Gingerols	76.1	18.70	—	—
Salicylic acid	49.1	12.07	33.5	13.32
Furulic acid	—	—	2.4	0.95
Cinnamic acid	12.4	3.05	11.4	4.53
Quercetin	87.1	21.41	67.3	26.76
Naringinin	4.9	1.20	5.8	2.31
Kaempherol	4.4	1.08	4.5	1.79
Chrysin	0.4	0.10	0.4	0.16
Paradol	1.2	0.29	—	—
Luteolin	—	—	3.0	1.19
Galangin	—	—	1.0	0.40

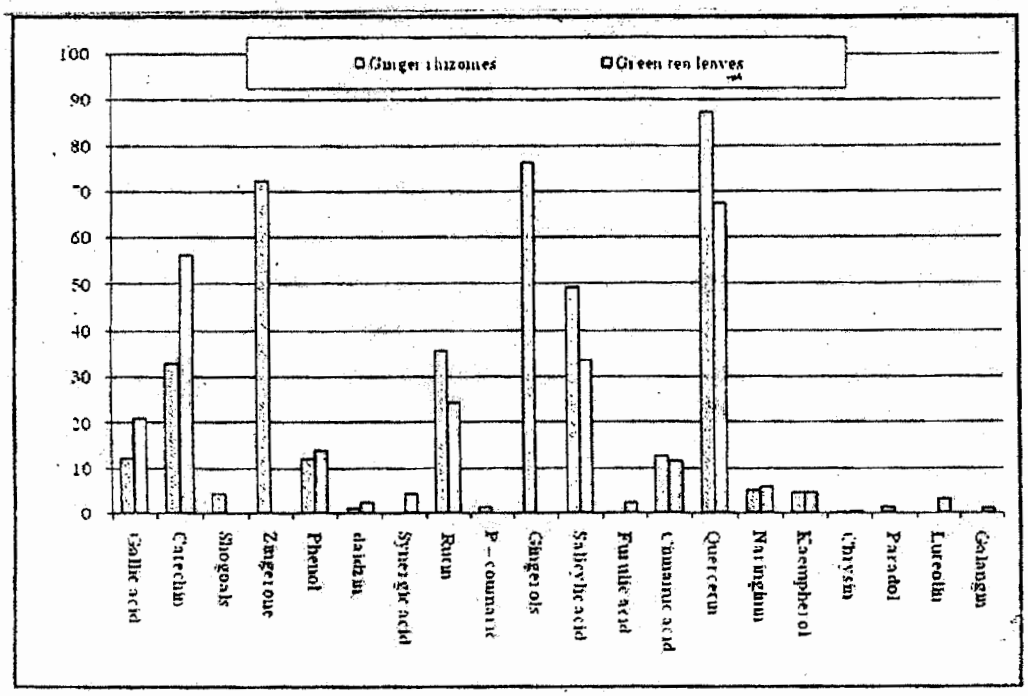

Fig. (2): HPLC analysis of polyphenols for ginger rhizomes and green tea leaves.

Takami *et al.,* (2008) investigated that green tea catechins and polyphenols extracted from the stalks and leaves of Camellia sinensis are found in the different types of tea beverages and as antioxidant additives to many foods.

GLC of volatial oil

The results in Table (4) and Fig. (3) demonstrate that ginger rhizomes volatial oil contains 25 components . The predominant components were : alpha - zingiberene , geranial , geraniol , alpha - terpinol , B-bisabolene , 1,8- cineol , borneoland nerol , with the amounts of 23.64 , 12.92 , 11.62, 8.77 , 8.29 , 7.97 , 7.64 and 7.62% respectively . While camphene , linalool and B- phellandrene were found in moderate amounts : 3.09 , 2.44 and 2.36% respectively .These results are in agreement with Martins *et al* (2001) who found that zingiberene was found as main constituent in essential oil of ginger

Table (4) and Fig. (3) show the individual components of volatile oil of green tea leaves. it contains 23 compounds ,four of them are predominant , 1 , 8-Cineol (37.83%) , terpinen – 4 – ol (20.58%) , γ-Terpinene (12.39%) and camphene (11.29%) , while , alpha -pinene , alpha - terpineol , nerol and borneol were presented in moderate amounts , their percentages were 4.19 , 3.54, 1.56 and 1.11% respectively . Our results are in agreement with that of Ninomiya *et al.,* (2012) , Chabir *et al.,* (2011) and Martins *et al.,* (2001) who found that essential oil of ginger contain 1 , 8-Cineole (25.5-34.4%) followed by p-pinene (14.1-15.2%) and alpha -terpineol (9.9-12.1%) .

Table (4): The individual components of essential oil for ginger rhizomes and green tea leaves (mg/100g dry weight).

Compounds	Ginger rhizomes		Green tea leaves	
		%		%
α – pinene	0.10	0.08	3.79	4.19
Camphene	3.81	3.09	10.21	11.29
β – Myrcene	0.89	0.72	0.81	0.90
α – phellandrene	0.20	0.16	0.39	0.43
β – phellandrene	2.90	2.36	0.40	0.44
1,8 – Cineol	9.81	7.97	34.20	37.83
Limonene	-	-	0.60	0.66
P – cymene	0.29	0.24	0.10	0.11
2 – heptanol	0.71	0.58	0.22	0.24
Camphor	0.10	0.08	0.38	0.42
Linalool	3.00	2.44	0.80	0.88
Sabinene	0.10	0.08	0.30	0.33
Myrcene	0.10	0.08	0.10	0.11
Neo – isopulegol	0.39	0.32	-	-
Bornyl acetate	0.31	0.25	0.69	0.76
Terpinen – 4 – oL	0.70	0.57	18.60	20.58
Citronellyl acetate	0.19	0.15	-	-
γ – terpinene	-	-	11.20	12.39
Geranial	15.91	12.92	0.71	0.79
α – Terpineol	10.80	8.77	3.20	3.54
Borneol	9.40	7.64	1.00	1.11
α – Zingiberene	29.10	23.64	-	-
β – Bisabolene	10.20	8.29	0.42	0.46
Geranyl acetate	0.12	0.10	0.58	0.65
Nerol	9.38	7.62	1.40	1.56
Geraniol	14.30	11.62	0.30	0.33
Zingiberenol	0.30	0.23	-	-

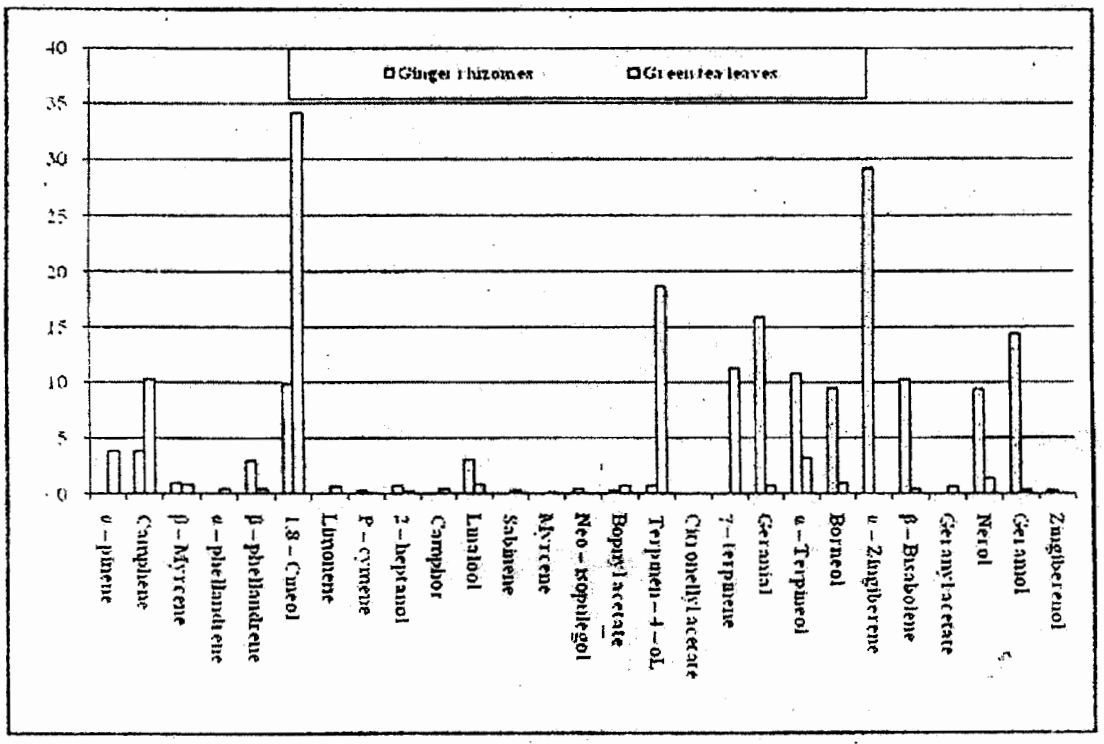

Fig. (3): The individual components of yolatial oil for ginger rhizomes and green tea leaves.

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دراسة مقارنة على الفينولات والزيوت الطيارة فى الجنزبيل والشاى الأخضر

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الملخص العربى

= وجد أن ريزومات الجنزبيل وأوراق الشاى الأخضر تحتوى على (17.70 , 13.72%) بروتين كلى – (7.3% , 4.81) ليبيدات خام – (57.6 , 68.18) كربوهيدرات كليه .

= كانت كمية الفينولات الكلية (٥١٠ , ٣٧٦ ملليجرام / ١٠٠جم ماده جافة)على التوالى .

= كانت الفينولات السائده فى ريزومات الجنزبيل هى : الكيورستين (٢١.٤٠ %) الجتجيرولز (١٨.٧٠ %) – الزنجيرون (١٧.٧٧%) – حامض الساليسليك (١٢.٠٧%) – الريوتين (٨.٧٠%) وأخيراً الكاتشين (٨.٠٦ %) .

= فى حين أو أوراق الشاى الأخضر إحتوت على الفينولات السائدة الآتية : كيورستين (٢٦.٧٦ %) – كاتشين (٢٢.٣ %) – حامض الساليسيليك (١٣.٣٢ %) – ريوتين (٩.٧ %) – حامض الجالبك (٨.٣٥ %) وأخيراً الفينول (٥.٥٧ %) .

= الزيوت الطيارة المستخلصة من ريزومات الجنزبيل إحتوت على المكونات الأتية :بكمية وفيره : ألفا زنجيرين (٢٣.٦٤ %) – جيرابنال (١٢.٦٢ %) وأخيراً جيرانيول (١١.٦٢ %) .

= الزيوت الطيارة المستخلصه من أوراق الشاى الأخضر إحتوت على المكونات السائدة الآتيه : ١.٨ – سينيول (٣٧.٨٣%) كحول – تربينين (٢٠.٥٨%) – جاما – تربينين (١٢.٣٩%) وأخيراً كامفين (١١.٢٩ %) .