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The Nutritive Value of *Cucumis melo* var. *agrestis* Scrad (Cucurbitaceae) Seeds and Oil in Nigeria

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Abstract: This study investigated the biochemical properties of the *Cucumis melo* var. *agrestis* seed and its oil. Also the effect of fungi on the biochemical properties of artificially infected oil after 14 days of incubation was determined. Eight fungi were isolated from diseased *C. melo* var *agrestis* seed during a six months period and monthly sampling from 3 markets in Lagos state, Nigeria. The fungi include *Aspergillus flavus*, *A. niger*, *A. wentii*, *Botrodiplodia theobromae*, *Mucor* sp. *Penicillium pinophylum*, *Phycomyces* sp. and *Rhizopus* sp. The moisture content of the usually healthy melon seeds was 4.50±0.73% and oil yield was 59.46±1.29%. The seeds also contained 30.40±1.09% carbohydrate and 3.89±0.55% protein. The extracted oil was edible and non-rancid with free fatty acid value of 1.94±0.34%; peroxide value of 8.00±0.56 meq kg^{-1}, iodine value of 10.50±0.81 and saponification value of 193.0±12.24 meq kg^{-1}. The fungi artificially inoculated on the oil changed its biochemical properties, turning the oil rancid. The melon seed sampled did not contain heavy metal lethal to human health.

Key words: Spoilage, fungi, melon seeds, biochemical property, heavy metal

INTRODUCTION

Six species of melon (family Cucurbitaceae) exist in Nigeria (Lawrence, 1951). These include *Citrullus lanatus* L., *Citrullus vulgaris* schrad, Cucumeropsis mannii Maud-Holl, *Cucurbita maxima* L., *Ccumis melo* and *Cucumis melo* var. *agrestis* Schrad (Adekunle, 1996).

Cucumis melo var. *agrestis* is cultivated in the middle belt (Niger and Benue states) of Nigeria. It is cultivated for its seeds and commonly called Egusi wewe in Yoruba (Dalziel, 1937). The plant prefers light moist soils, which may be acidic, neutral or basic. It is cultivated between April and October of the year.

Biochemically, healthy melon seeds contain 63% oil, 3.8% proteins and 1.0% carbohydrate (Coursey, 1964). Lipids found in exceptionally high concentrations in melon seed oil are triacyglycerols and glycerol, with one or more fatty acid. Lipid degradation occurs when seeds are exposed to certain micro-organisms or during germination.

The seeds of *C. melo* var. *agrestis* are smaller in size compared to other melon seeds and are covered with a fibrous coat. The fruits have a bitter flavour and can be used as a cooling light cleanser or moisturizer for the skin and also as first aid treatment for burns and abrasions (Burkhill, 1985). The root is diuretic and emetic. Sprouting seeds of melon produces toxic substances in its embryo and the seeds has antitussive, digestive, febrifuge and vermifuge properties.

Seeds in storage could be attacked by fungi, bacteria, insects, viruses and other plant pathogens. Fungi being the commonest agent (Christensen, 1957), causing various types of deterioration including discolouration, destruction of viability, spoilage of flavour, biochemical changes, weight losses, rotting and caking (Oyeniran, 1980). Fungi could also use up food stored in the endoperm of the cotyledon (Adekunle and Uma, 1997), thereby drastically reducing the germinability of the seeds.

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Damage due to fungi is more difficult to access especially as stored products are never free from fungi (Oyeniran, 1980). The importance of biodegradation of oilseeds and oil extracted from both seeds and oils (Lever, 1990).

To confirm the identity of most oils, it is normally considered sufficient to determine the iodine value, saponification value, unsaponifiable matter, Free Fatty Acid (FFA) value and peroxide value coupled with qualitative tests for appropriate adulterants (Hamilton and Rossell, 1986). The rancidity of the oil will also indicate the quality of the food for oil and affect its uses for soap (Kirk, 1991), cream production and edibility, nutritive value of the seeds and oil extracted from the seeds of *Cucumis melo* var. *agrestis* as well as the antifungal activity of the extracted oil have not been reported in Literature. The fungi associated with the spoilage of *C. melo* var. *agrestis* seeds during storage have also not been reported.

As a continuation of studies in this laboratory on the composition of indigenous African seed plants for food, the nutritive value of *C. melo* var. *agrestis* seeds and its oil is presented here. Also reported are some of the biochemical properties (saponification value, unsaponifiable matter, peroxide, FFA value and Iodine value) and antifungal properties of the oil extracted from the *C. melo* var. *agrestis* seeds. The pathogenic fungi associated with the spoilage of *C. melo* var. *agrestis* in the market (storage) will also be investigated.

MATERIALS AND METHODS

Source of Plant Materials

The seeds of *Cucumis melo* var. *agrestis* (2000 g) was collected from Oyingbo, Bariga and Yaba markets in Lagos state, Nigeria. The seed samples were collected (2000 g) monthly for six months. The seeds were packed in plastic bowls (covered) and stored in a refrigerator prior to use. The percentage moisture content of the seeds were determined at 103°C at 17 h as described by Agrawal (1980).

Isolation, Identification and Pathogenicity Test of Fungi

One hundred visually infected seeds were obtained from each of the market sample and were surface sterilized by leaving them in a solution of sodium hypochloride (common bleach, 40%), for a minute and rinsed in 3 changes of sterilized distilled water. Foru seeds were then placed on previously prepared potato dextrose agar plates (25 plates). The plates were then incubated at room temperature (28-31°C) and observed daily for fungal growth. To identify the fungi, morphological studies of the fungi were carried out. Microscopic studies of the fungi were carried out and the identity of the fungi was confirmed by comparing their morphology with fungal description in text such as Talbot (1971), Deacon, (1980) and Bryce (1992) and also by a mycologist in the department of Botany and Microbiology, University of Lagos, Nigeria. Pathogenicity test of the fungi isolated from *C. melo* var. *agrestis* was carried out according to the methods of Booths (1971).

Composition of *C. melo* var. *agrestis* Seeds

The percentage carbohydrate content of the *C. melo* var. *agrestis* seed was determined using the methods of Egan *et al*. (1981). The methods of Lowry *et al*. (1951) was used to determine the percentage protein content of *C. melo* var. *agrestis* seeds while the ash content of the seeds was determined using Diamond and Denman (1973) methods. Healthy and unhealthy (visually infected from the field) seeds were used.

Extraction of Oil

The method of oil extraction from *C. melo* var. *agrestis* was adopted from the oil extraction methods of Egan *et al*. (1981). Extraction was done from healthy and diseased seeds separately.

Biochemical Properties of the *C. melo* var. *agrestis* Seeds Oil

The quantity of oil extracted from the seeds was determined as a percentage of the oil extracted, expressed over the weight of the seeds used as described by Diamond and Denman (1973). The method of Anonymous (1990) was used to determine the quality of oil extracted from the seeds, the saponification, unsaponifiable matter, peroxide value and iodine value. The Free Fatty Acid (FFA) value was determined according to the method of Egan *et al*. (1981).

Antifungal Activity of the Oil Extracted from *C. melo* var. *agrestis* Seeds

A modification of the paper disc diffusion method of Irobi and Daramola (1994) was used here as described by Adekunle and Badejo (2000).

Effect of Fungi on the Biochemical Property of Artificially-infected *C. melo* Var. *Agrestis* Oil

Ninety milliliters of the extracted oil (oil from healthy seeds) was measured into nine test tubes at 10 mL per test tube. A tenth test tube contained 10 mL of ol extracted from unhealthy seeds (from the market). Spore or conidia suspension of 105-107 cells, counted with haemocytometer were prepared from pure cultures of eight fungal species previously isolated from unhealthy *C. melo* var. *agrestis* seeds sampled from the markets. The fungal species were *Aspergillus flavus*, *A. niger*, *A. wentii*, *Botrodiplodia theobromae*, *Mucor* sp. *Penicillium pinophylum*, *Phycomyces* sp. and *Rhizopus* sp. One milliliter of the spore or conidia suspension was added to 8 of the test tubes (containing healthy oil), with one fungal species per test-tube. The ninth test-tube served as one of the controls and 1 mL of sterilised distilled water was added to it with no fungal inoculum. The tenth test-tube served as a second control and contained 10 mL of oil extracted from unhealthy seeds sample from the market. One milliliter of sterilised distilled water with no fungal inoculum artificially added. There were three replicates of each test-tube and control. All test-tubes were shaken vigorously with an electric shaker for 1 h. Thereafter, the test-tubes were shaken everyday for 30 min. After 14 days of incubation, the biochemical property (FFA, Peroxide, Iodine, Saponification value and unsaponifiable matter) of the artificially infected oil in the test-tubes was assessed as described earlier. The experiment was repeated thrice. The results were analysed using Standard Deviation (SD), analysis of variance (ANOVA), F-test and Duncan's multiple Range test (Parker, 1979).

Heavy Metal Analysis

The heavy metal analysis of the melon seeds was carried out at the Federal Institute of Industrial Research (FIIRO), Oshodi, Nigeria. One gram of the ground seeds sample were weighed into an already weighed crucible. The crucible was placed on the flame of a burner to burn off the carbon. This was then put in an Eurotherm furnace at 550°C for 1 h to ash the seed sample. The ash was allowed to cool and was then weighed to obtain the percentage ash content. The ash was dissolved in 1 mL distilled water placed into a 100 mL volumetric flask and 1 mL of hydrochloric acid (HCl) was added and gently shaken for proper homogenisation. The volume of the solution was made up to 100 mL of the flask using distilled water. This was then placed in Atom Absorption Spectrometer (AAS) to aspirate for the presence of heavy metals. Aspiration was done by using Hallow Cathode Lamps for each metal and the percentage concentration of each heavy metal was measured against a standardized (Solomon, 1992).

RESULTS

The nutritive value of healthy and unhealthy (mixed infection) *Cucumis melo* var. *agresitis* seeds is shown in Table 1. The oil content of the healthy melon seed was 59.46±1.29% while that of the unhealthy seeds was 50.35±1.44%. There was a significant decrease of the Carbohydrate content of

Table 1: Biochemical properties of healthy and unhealthy (Infected) *Cucumis melo* var. *agrestis* seeds

Samples	Moisture content	Oil content	Carbohydrate content (%)	Protein content (%)	Ash (%)
Healthy seed	4.50±0.73a*	59.46±1.29c	30.40±1.09e	3.89±0.58g	2.48±0.18h
Unhealthy (mixed infection from market) seed	5.02±0.81b	50.35±1.44d	38.17±1.75f	3.24±0.27g	2.21±0.13h

*Samples with different letter (s) show significant difference (p = 0.01), Samples similar letter (s) show in-significant difference (p = 0.01)

Table 2: Effect of fungi on the quality of *Cucumis melo* var. *agrestis* (After 14 days incubation) seed oil

Samples	Free fatty acid (%)	Iodine value	Peroxide value (meq kg^{-1})	Saponification value mg KOH g^{-1}	Unsaponifiable matter (g kg^{-1})
Control (oil extracted from healthy seeds)	1.94±0.34	10.50±0.81	8.00±0.56	193.0±12.24	1.94±0.47
Oil from unhealthy (market infected) seeds	6.26±0.20	9.20±0.73	13.50±1.23	185.0±11.32	1.26±0.43
Oil with *Aspergillus flavus*	5.25±0.30	9.60±0.84	15.70±1.25	183.0±10.76	1.30±0.54
Oil with *Aspergillus niger*	4.20±0.65	9.50±0.78	14.70±1.38	179.0±11.84	1.18±0.78
Oil with *Aspergillus wentii*	4.21±0.24	9.70±0.74	14.20±1.96	176.0±10.31	1.16±0.65
Oil with *Botryodiplodia theobromae*	4.16±0.70	10.10±0.75	14.00±1.42	180.0±11.75	1.22±0.89
Oil with *Mucor* sp.	2.99±0.96	9.10±0.63	13.80±1.86	180.0±12.83	1.14±0.81
Oil with *Penicillium pinophylum*	4.10±0.44	9.30±0.45	14.70±1.35	186.0±11.96	1.44±0.34
Oil with *Phycomyces* sp.	3.05±0.89	10.00±0.28	14.10±1.60	181.0±11.04	1.37±0.34
Oil with *Rhizopus* sp.	3.19±0.88	9.80±0.46	14.00±1.15	180.0±11.55	1.32±0.42

the healthy seed (30.40±1.09%) to the unhealthy melon seed (38.17±1.75%). There was an insignificant increase in the protein content of the unhealthy seed to the healthy melon seed (Table 1).

There was a significant increase in the free fatty acid (%) content of artificially infected oil and oil extracted from unhealthy seeds from the markets, compared to the oil from the healthy seeds (Table 2). The highest increase in the FFA was from the unhealthy (mixed infection) seed oil (6.26±0.20%). There were changes in the peroxide value, iodine and saponification values of the infected and healthy oil. There were significant changes by each of the fungi on the biochemical properties of the oil. *Aspergillus flavus* had the highest value of the biochemical property tested, while *Mucor* sp. had the least value (Table 2).

The oil extracted from the seeds of *Cucumis melo* var. *agrestis* was not active against the fungi tested. The Fulcin and Benlate controls showed zones of inhibition against the fungi.

Heavy metal analysis of the melon seed shows that the seeds did not contain heavy metals such as cadmium, chromium, lead, nickel and zinc.

DISCUSSION

This study showed that the oil of *Cucumis melo* var. *agrestis* seeds is edible. The qualitative properties of the oil fits the description of the edible oils by Kirk (1991). The peroxide value of the melon seed oil was 8.00±0.56 meq kg^{-1}. Kirk (1991) explained that peroxide value below 10 meq kg^{-1} showed that the oil involved is a non-rancid oil. Also, the FFA content of the healthy melon seed oil was 1.94 ±0.34% and below the 5.00% FFA content recommended for non-rancid oil (Ekundayo and Idzi, 1990), implying that the oil is not rancid. However, the artificially infected oils were rancid because the FFA value was between 5.25± 0.30 and 2.99±0.96%. Aspergillus flavus caused the most devastating effect on the quality of artificially infected oil and support earlier study by Kuku (1979) and Adekunle and Badejo (2000).

This study also reveals that the pathogenic fungi isolated from the diseased *Cucumis melo* var. *agrestis* seeds caused biochemical changes in unhealthy seeds, deteriorating them. It was observed that the fungi might be converting the oil content (which was decreasing in infected seeds) to carbohydrate

(which was increasing). The fungi were probably using the carbohydrate produced from such activities for their metabolic activities, this supports other works by Ekundayo and Idzi (1990) on *Citrullus vulgaris* and other species of melon (Cohan, 1978; Fokou *et al*., 2004). The extracted oil from *C. melo* var. *agrestis* seed did not show any antifungal property since it was not active against all the fungi tested.

The result of this study indicated the oil of *C. melo* var *agrestis* seeds to be edible, non-rancid and saponifiable. The presence of fungi in the oil will change its biochemical composition and nutritive value, making it rancid. Thus, proper storage and extraction under adequate sterile conditions are recommended.

The melon seed sample from the markets showed absence of heavy metals which is a good indication that the seeds were safe for consumption in terms of heavy metal composition.

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