

Assaying the Relationship Between Resistivity and Concentration in *Ocimumgratissium* Flavor Extracted by Traditional and Conventional Methods

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Abstract: The extract of basil leave were prepared by two different methods; modification of an African cultural practice where specified weights in grams (between 100 and 300) of (non blemished, dust free) fresh basil leaves were harvested stalk free and heated (incinerated) stuffed in a clay earthenpot on a charcoal stove for nine (9) hours. The partially charred leaves were discarded and the pot thoroughly washed with 300ml distilled water. Finally, 200ml of distilled water was poured into the pot, covered and allowed to stand for 12 hours, before storing the water at 4°C in tightly sealed plastic containers, labeled as subunits of sample A. In the second procedure, basil leaves collected as in the first procedure were in separate batches stuffed into the distillation bottle with 200ml of distilled water. Distillation was carried out for 2 hours and distillates collected and stored in tightly sealed plastic bottle labeled as subunits of sample B. The samples (A and B) including their subunits were (within 30 minutes of extraction) subjected to spectrophotometry, pH, and Total soluble solids (TSS) analysis. A 20 man trained panelist were employed in sensory evaluation of the (300g leaf) extracts (after storing at 4°C for 96hours) in terms of colour, flavour, flavour interference and general acceptability. Furthermore, 20ml of each (300g leaf) extract of A and B were poured into a curvet of 2mm pathway. These were one after the other placed into an electric circuit with the poles submerged into opposite ends of the curvet. The following parameters were read from the meters when the circuit was completed: current, voltage and resistance to flow of electricity across the sample. Sample A (the extract made by the modified traditional practice) had the highest general acceptability compared to sample B and the natural leaf (control sample). It had significantly lower color and flavor interferences, with average of 8/10 flavor intensity recording. Resistance to flow of electricity for both samples (A and B), were inversely proportional to leaf or flavour extract concentration with a gradient of 0.001. It is therefore possible to compute concentrations of flavor components from resistance to flow of electricity with gradient and intercepts derived from graph (Figure 1). TSS, pH and temperature of samples followed the same pattern as electrical resistivity.

Keywords: Flavor, Extraction, Earthenware, Resistivity, Quantification

1. Introduction

‘Nchuanwu’ (*Ocimumgratissium*) is used extensively among the Igbos, not only for spicing of cultural pepper soup and various (meat) porridges but helping the relief of certain forms of stomach upsets. Scent leave or tea bush is also put

into one use or the other by several other African groups commonly for its anti inflammatory properties and pleasant fragrance due to its component of methyl eugenol, linol and terpinol all aromatic compounds [5, 6, 8]. Scent leave has also been associated with anti microbial (antifungal) properties as well as anxiolytic (ability to impact

positively on anxiety).

The electrical properties of oil depend mainly on its chemical composition. Electrical resistivity and dielectric strength are the main electrical characteristics of a substance. Electrical conductivity of oil is due to the presence of free charges which move under the influence of an electric field, producing an electrical current. Consequently the electric resistivity is the reciprocal of electric conductivity. The electrical properties and qualities attributed to essential oils (flavorings) might be responsible for the aroma therapeutic capabilities attributed to them [11].

They may also provide scientific explanations for some traditional or cultural practices of water treatment seen in some African localities. The Indigenous people had a practice of incinerating the pod of 'uhiokirihio' in ceramic wares. After the incineration process, the ceramic wares were used in the storage of drink or table water. The water was known to retain the flavor of the incinerated pod for up to seven days. Such plant extracts were also associated with anti-microbial effects. Charcoal from hardwoods were employed during such incineration practices. After the incineration and thorough washing of the pot, drink or table water that was stored in the pot (covered), extracted and retains the flavor of the incinerated plant material (at least seven days after).

This principle might be similar to what obtains in ion exchange chromatography, electropositive and electronegative bodies (charged moieties like those of essential oil/flavor components) are carried or attached to supports (like ceramic beads etc.) and can be desorbed or detached when suitable solvents are applied. Studies by [1, 3, 4, 12] all attested to minimum toxicity of properly kilned earthenware.

There is a lot of value and acceptability placed on the aroma/flavor as well as the medicinal/ nutraceutical potentials of *Ocimum gratissimum*; enough to warrant this research effort aimed at extracting and quantifying a chlorophyll free flavor solution of this leave for possible incooperation into appropriate food preparations (www.awaycande.com). Pigment free flavor extracts (of known and acceptable concentrations) from GRAS (generally regarded as safe) materials, will continue to be highly valuable in the food and pharmaceutical industries.

2. Materials and Methods

This is a modification of cultural technique or procedure practiced in Umuahia, metropolis in Abia state, South-east of Nigeria. The '*Nchuanwu*' leaves (50g), picked from the plant without the leave-stock were incinerated using 50g of commercial charcoal for 24hrs while enclosed in a clay pot (8cm diameter and 9cm in height). The clay pot (after incineration) was rinsed with 500ml of table water. Then 200ml of table water was poured into the pot, covered and allowed to stand in a cool place. Starting with the day of treatment as day one, samples were withdrawn for five days for analysis. Degree brix, pH, absorptivity and specific gravity of the samples were assessed. Sensory evaluation was employed in the comparison of degree of flavor retention,

color and overall acceptability among samples. In the second procedure, basil leaves collected as in the first procedure were in separate batches stuffed into the distillation bottle with 200ml of distilled water. Distillation was carried out for 2 hours and distillates collected and stored in tightly sealed plastic bottle labeled as subunits of sample B [10].

The flavor extracts (sample A – prepared by a modification of traditional water treatment practice; sample B – prepared by distillation) were subjected to sensory evaluation using a 20 man trained panelist with the fresh leaf as control. The parameters compared are intensity of 'nchuanwu' flavor, interference by other flavors example chlorophyll, color and overall acceptability.

Employing an electric circuit comprised of voltmeter, ammeter and Resistor. The following parameters were assessed for samples A and B; electrical resistance and conductivity at a fixed voltage. In addition, density, specific gravity, Total soluble solids (TSS) and pH of the samples were assayed according to the specified methods.

3. Results

The flavor intensity F for A (prepared by modified traditional method) was 8 and was not significantly different from that of B and the control (natural leave) which were respectively 7 and 10. In terms of interference however, sample B gotten by distillation had some after taste effect traceable to chlorophyll which perhaps made it less acceptable (5) compared to (9) higher acceptability of A (see table 1)

The electrical conductivity for '200g leave/500ml water' sample was 133 while that of '25g leave/500ml water' was 96. The corresponding resistances to flow of electricity were respectively 4.77 and 5.58. With the B, the resistances to flow of electricity were respectively 4.66 and 4.95 for 200g leave and 20 g leave.

4. Discussions

Resistance to flow of electricity seems to be decreasing with increasing concentration of leaf/ flavor extract though slowly but steadily, giving a low gradient of 0.001 (Tables 2 and 3). The same trend applied to TSS and pH. Temperature during reaction, had an opposite trend; reducing with reducing concentration. It might be that ionization was reducing which is in agreement with the reducing TSS and flow of electric current. From a standard graph of electrical resistance versus concentration of flavor concentration, it is possible to calculate the flavour concentration of new preparations Souad et al [11] also highlighted this direct relationship between flavor concentration and resistivity to flow of electricity. This fact, coupled with the 8/10 sensory evaluation score (for flavour intensity) made by the extract from the modified traditional method (Table 2), portrays this method as one with great potential for the food and pharmaceutical industry [7].

5. Conclusion and Recommendation

Research works that are based on original and cultural ideas and practices, should be supported by the international community. It has a greater potential of good results and hence benefit to mankind since issues of health hazard might not be critical having been practiced for long (centuries in some cases) among a large population. In the chance that such practices scientifically predisposes to some other remarkable forms of health hazards, there is need for early enough warning.

This research has demonstrated a practical and relatively

cheaper procedure for extraction of colorless (chlorophyll free) flavor from spices and some medicinal herbs by exposing and adopting (after modification) of an age long yet almost undocumented cultural practice.

The work also demonstrated that from a standard graph of electrical conductivities of (water) extracts of (leaves) flavor carrying plant material, versus the quantity of the (leaves) flavor carrying components (in fixed quantity of water) solvent, it is possible to calculate flavor concentrations in the extracts

Therefore, this research has a lot of potentials for the food and pharmaceutical industries [14, 15].

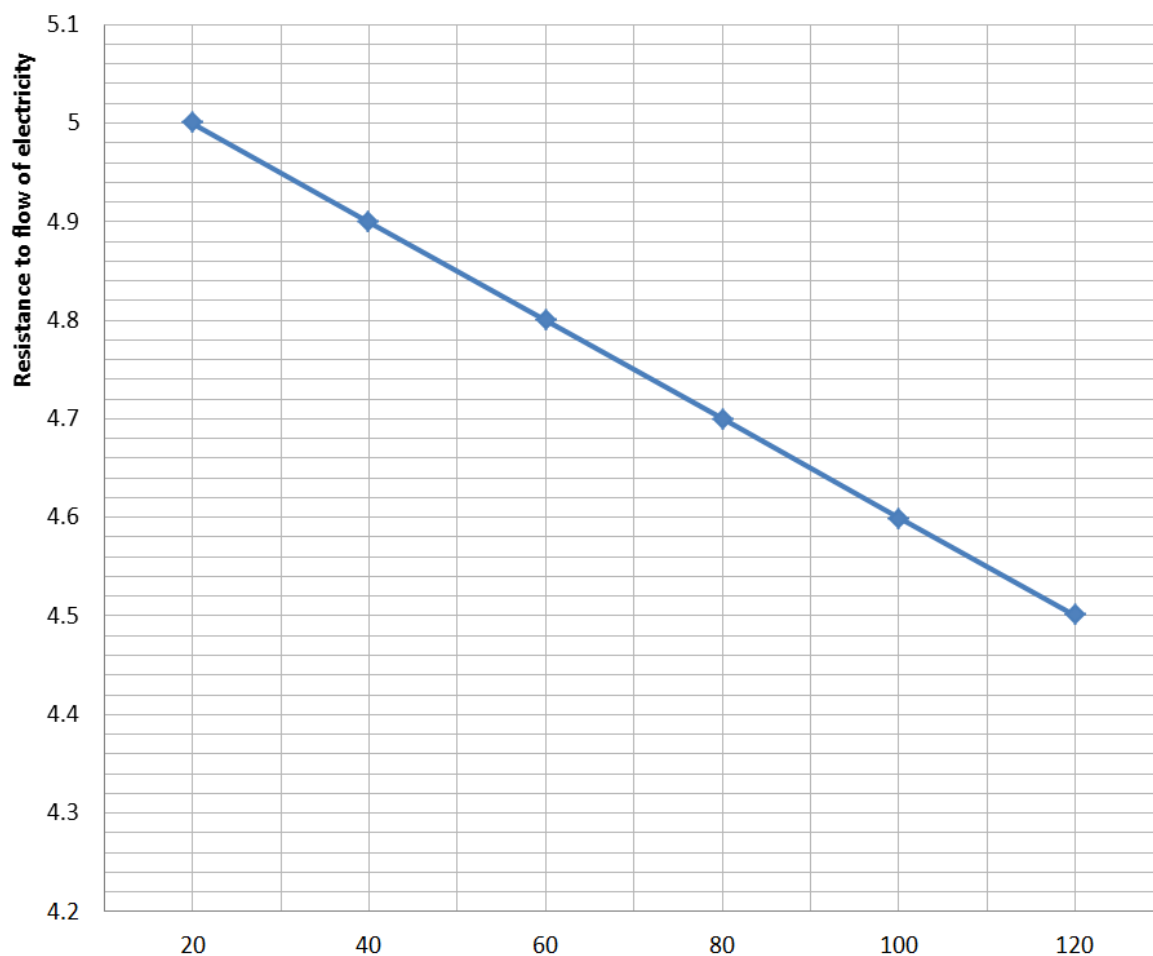


Figure 1. Graph of Concentration against resistance (from sample A; Table 2).

Table 1. Sensory evaluation results of flavour extracts from 'Nchuanwu' leaves.

Parameters				
Samples	F ₁	F ₂	Colour	(OA)
A	8±0.50 ^a	1± 0.1 ^a	0±0.1 ^a	9±0.9 ^a
B	7±1.0 ^a	6±0.8 ^b	3±0.9 ^b	5±0.8 ^c
Control	10±0.9 ^a	1±0.4 ^a	10±0.6 ^c	7. ±0.3 ^b

Mean± SD with same superscript across column, are not significantly different ($p \leq 0.05$)

F₁=Flavour intensity

F₂=Flavour Interference

A='Nchuanwu' flavour extracted by modified traditional procedure

B=Nchuanwuflavour extracted by distillation.

OA=Overall acceptability

Table 2. Result of Analysis on sample A (flavour extracted by modified traditional practice).

Parameters	Varying Quantities of leaf (g)					
	0	200	150	100	50	25
Electrical conductivity	15±3 ^a	133±0.4 ^b	101±0.5 ^c	100±0.5 ^c	98±0.9 ^c	96±0.4 ^c
pH	6.7±0.1 ^d	7.29±0.1 ^a	7.81±0.3 ^b	7.19±0.2 ^a	7.48±0.3 ^c	7.33±0.4 ^c
TSS	60±0.5 ^a	52±0.1 ^b	54±0.3 ^b	56±0.3 ^b	52±0.9 ^b	59±0.2 ^a
Temperature (°C)	23.4±0.2 ^a	23.5±0.1 ^a	23.9±0.2 ^a	24.7±0.1 ^b	22.9±0.2 ^a	23±0.1 ^a
Total acidity	0.0003	0.0002	0.0002	0.0002	0.0003	0.0002
Resistance (Ω)	5.40±0.1 ^a	4.77±0.2 ^b	4.82±0.1 ^b	5.10±0.3 ^a	5.30±0.4 ^a	5.58±0.7 ^a
Voltage (V)	008	008	008	008	008	008
Current (A)	1.48±0.01 ^a	1.67±0.02 ^b	1.65±0.01 ^b	1.63±0.02	1.51±0.02 ^a	1.43±0.02 ^c
Specific gravity	1.027±0.02 ^a	0.95±0.01 ^b	0.95±0.002 ^b	0.95±0.001 ^b	0.93±0.001 ^b	0.95±0.001 ^b

Mean±SD with same superscript across row are not significantly different (p≤ 0.05)

Table 3. Result of Analysis on sample B (flavour extracted by Distillation).

Parameters	Varying Quantities of leaf (g)										
	0	200	180	160	140	120	100	80	60	40	20
Electrical conductivity	10±.1 ^a	110±.9 ^b	117±.1 ^b	110±.1 ^b	114±.1 ^b	113±.1 ^b	104±.2 ^c	132±.2 ^d	112±.1 ^b	136±.1 ^d	133±.1 ^d
PH	6.7±0.1 ^a	7.09±.2 ^b	7.06±.1 ^b	7.14±.2 ^c	7.18±.1 ^c	7.33±.2 ^c	7.03±.1 ^b	7.08±.3 ^b	7.15±.1 ^c	7.02±.1 ^b	7.29±.2 ^c
TSS	60±.5 ^a	51±1.0 ^c	56±1.2 ^c	50±.8 ^c	60±1 ^a	53±.9 ^c	52±2.0 ^c	61±1.1 ^a	64±.9 ^a	66±2 ^b	68±1.5 ^b
Temperature (°C)	26±.2 ^a	26±.1 ^a	25.9±.2 ^a	25.5±.3 ^a	25.9±.1 ^a	25.9±.1 ^a	25.8±.2 ^a	25.8±0.3 ^a	25.3±0.1 ^b	25.8±.1 ^a	25.8±0.1 ^a
Total acidity	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001
Resistance (Ω)	4.66±.5 ^a	4.68±.1 ^a	4.74±.3 ^a	4.75±.2 ^b	4.77±.8 ^b	4.78±.1 ^b	4.81±0.1 ^b	4.86±.1 ^c	4.89±0.5 ^c	4.90±0.9 ^c	4.95±1.0 ^c
Voltage (V)	8	8	8	8	8	8	8	8	8	8	8
Current (A)	1.72±.01 ^a	1.70±002 ^a	1.89±.01 ^b	1.68±.01 ^a	1.68±.02 ^a	1.67±.01 ^a	1.66±.03 ^c	1.65±.01 ^c	1.64±0.03 ^c	1.63±0.06 ^c	1.62±0.05 ^c
Brix ⁰	0	0	0	0	0	0	0	0	0	0	0
Specific gravity	1.027±.002 ^b	0.95±.003 ^b	0.95±.003 ^b	0.95±.003 ^b	0.93±.02 ^b	0.95±.01 ^b	0.95±0.1 ^b	0.93±.01 ^b	0.95±.02 ^b	0.93±0.01 ^b	0.93±0.1 ^b

Mean±SD with same superscript across row are not significantly different (p≤ 0.05)

Wight of leaf (g) / 500ml water

$$\text{Gradient} = \frac{\Delta y}{\Delta x} = 0.001$$

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