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Quality assessment of meat patties cured with *Ocimum Gratissimum* extract

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Abstract

The effect of O*cimum gratissimum* extract (OGE) on meat patties made from three different meat types namely beef, chevon and pork was investigated. Each meat type cured in OGE at different curing periods of 0hr, ½ hr, 1hr, 1 ½ hrs and 2 hrs were represented as treatments A B C D and E..O*cimum gratissimum seeds* were planted and extract of harvested matured leaves were used for meat curing. Meat cuts from the thigh portion of matured carcasses of bulls, bucks and boar were purchased from the meat market at Igbo-ora,45 minutes after slaughtering. Each meat type were sliced into 10 replicates, samples were randomly allotted into the five treatments in a factorial arrangement and were minced after curing. The minced meats were then shaped into round moulds, grilled in oven at 115^{o}C for 25mins and assessed for organoleptic properties. Meat patties of beef and chevon cured with O*cimum gratissimum* extract for 1 hr and 1½ hrs gave better overall acceptability while control and ½ hr soaked pork patties were preferred to patties from other curing times.. Finally, the overall acceptability of *ocimum* cured beef, chevon and pork patties rating showed that treatment B, C and D were significantly ($P<0.05$) different with different mean values range of 6.81±6.91 (Beef), 6.11±6.80 (Chevon) and 5.89±6.26 (Pork) while treatment E had the least mean values with least acceptance. It could be inferred from this that the taste became more appreciated in patties cured for ½ hr and 1 hr in *ocimum extract* according to the rating of the panelist.

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Introduction

Meat is the flesh of animal taken as food, and often it is known as the skeletal muscle that is associated with fat and other tissues, but may also describe other edible tissues such as organs and offals (Lawrie, 2006). Beef being a good source of protein provides 64.1% of daily value protein in just 4 ounces It is also a good source of vitamin B12 (along with vitamin B6 and folate) and nutrients needed by the body to convert the potentially dangerous chemical homocysteme into other benign molecules (Hyun *et al.*, 2004). Beef is the third most widely consumed meat in the world (FAO, 1990), accounting for about 25% of meat production worldwide, after pork and poultry at 38% and 30%, respectively. Chevon from adult goats is more palatable to consumers (Fletcher *et al.*, 2008). Goat meat has the tendency for a strong, gamey flavour, but can be mild depending on how it was raised and prepared (Alford *et al.*, 2009). Despite being classified as red meat, goat is leaner and contains less cholesterol and fat than both lamb and beef (Fredrick *et al.*, 2004). Although, pork is very high in thiamin (Vitamin B1) but its myoglobin content is lower than that of beef, but higher than that of chevon. Pork with trimmed fat is leaner than the meat of most domesticated animal and higher in cholesterol and saturated fat (Raloff *et al.*, 2003). Fresh meat can be cooked for immediate consumption, or processed. Therefore, in the course of processing fresh meat medicinal plants can be used as curing agents rather than synthetic chemicals. Medicinal plants remain the main stay for about 75-80% of the world's population especially in the developing countries for primary health care. This is because of the general belief that these plants are without side effects when they are used and are cheap and locally available.

The use of plant for healing purposes predates human history and forms the origin of most modern medicine plants play effective roles in the production of drugs, this calls for the need to explore the versatility of *Ocimum grattissimum* (Scent leaf) which is widely used in Africa and Asia. This plant belongs to the family labiatae and the most abundant of the genus *Ocimum*. called "Effirin" in Yoruba. "Nchonwu" in Igbo, while in the Northern part of Nigeria, the Hausas call it "Daidoya" (Effraim *et al.*, 2001). It is a perennial plant that is woody at the base. It has an average height of 100-150cm high. The leaves are broad and narrowly ovate, usually 5-13cm long, and 3-9 cm wide. It is a scented shrub with lime-green fuzzy leaves.

Photochemical evaluation of this plant has shown that it is rich in alkaloid, tannins, phytate, flavonoids and Oligosaccharides (Ijeh *et al.*, 2004). It has tolerable Cyanogenic content (Ijeh *et al.*, 2004). The volatile aromatic oil from the leaves consist mainly of thymol (32-60%) and eugenol; it also contains Xanthenes, terpenes and lactones. (Ezekwesili *et al.*, 2004). Characterization of its ethanol extracts revealed the presence of non-cyclic sesquiterpense, phenols (Esvanzhuga, 1986).

Ocimum gratissimum is extensively used throughout West Africa as a *febrifuge*, and anti-convulsion. Its juice is used in the treatment of convulsion, stomach pain and catarrh. Oil from the leaves have been found to possess antiseptics, antibacterial and antifungal activities (Ezekwesili *et al.*, 2004). In the coastal area of Nigeria, the plant is used in the treatment of epilepsy, .high fever (Oliver, 1980) and diarrhea (Oliver, 1980 and Sofowora, 1993). While in the savannah areas decocted leaves are used to treat mental illness (Abdulrahman, 1992). *Ocimum gratissimum* is used by the Ibos in southern Nigerian in the management of the baby's cord. It is used to keep the baby's cord and wound surface sterile.(Iwu, 1996), Clinical trials in creams formulated against dermatological disease have yielded favourable result (Edeoga *et al.*, 2001). Nutritional importance of this plant centers on its usefulness as a seasoning because of its aromatic flavour (Ezekwesili *et al.*,2004).

The study aimed at: Evaluating the proximate composition of *ocimum gratissimum* and quantifying the inclusion levels of *OGE* that would enhance the eating quality of meat patties made from the three meat types. And exploring the best timing of curing

meat with *OGE* that would favour the best eating quality of the meat types.

Materials and methods

Extract Preparation

Matured fresh leaves of *Ocimum gratissimum* were collected, weighed and rinsed with distilled water. The leaves were finely blended and squeezed with the use of muslin cloth to extract the juice. A brownish light green juice was obtained, then measured in a volumetric flask and kept in the refrigerator for use the same day.

Meat Preparation

Fresh meat types (beef, chevon and pork) were bought from the slaughter slab at Igbo-Ora market and College slaughter slab early in the morning 45 minutes after slaughtering. The cut of beef, pork and chevon used in this experiment were from the thigh region of matured animals and were trimmed of all visible bones and connective tissues. Ten kilogram meat types were rinsed with distilled water, and weighed accordingly.. Each meat type was portioned into 2kg each and then allotted into treatments in a Completely Randomized Designed in factorial arrangement in all meat types. The meat samples were then soaked in *Ocimum gratissimum* extract before grinding. TA served as the Control- not cured in OGE, while TB, TC, TD and TE were cured in OGE for ½ , 1, 1½ and 2 hours respectively, and then each meat type was milled with a meat grinder out of which meat patties were made. Each meat type had 10 replicates per treatments giving a total of 50 meat patties per meat type with an average weight of 180 - 200grams each. Newly bought distilled rinsed Petri dishes. The samples were grilled in the oven for 25 minutes at 115°C.

Taste Panel Evaluation

Forty semi trained panelists were used to evaluate each of the 10 replicates of the meat product. The panelist rated the samples on a nine- point hedonic scale with maximum score of 9 for extremely high conditions while the lowest score of 1 was assigned to the poorest condition (Mahendraker *et al.,* 1988). Each sample was evaluated independent of the other. The parameter evaluated for include: Color, Flavor, Tenderness, Juiciness, Texture and Overall acceptability.

Statistical Analysis

Data collected from the evaluation were analyzed using the procedure of statistical analysis system SAS (SAS 1999).

Discussion

Results from the study revealed that Table 2 and 3 show the proximate composition of *Ocimum gratissimum* leaves and fresh meat types respectively. Scientific meat composition by the researchers revealed that meat consist of approximately 75% moisture and 25% dry matter while values obtained in this study seems not differ across the meat types.

The proximate composition of meat patties cured with *Ocimum gratissimum* extract below are revealed in Table 4 An over view of the result showed no significant differences in the dry matter content of patties from the different meat types. The values obtained for crude protein followed the same trend. Variations were observed in the ether extract content of patties from the meat types; the values were highest for pork patties while chevon patties gave the least values. The ash content for all patties ranged from 1.70 in the pork patties (without OGE) to 2.21 in beef patties cured with *ocimum* for 1.5 hrs. The ash content for beef, chevon and pork patties is an indication of the mineral content of the patties.

Table 1. Ingredients recipes used for meat patties g/g.

Butter	Binder (flour)	Salt	Sugar	Thyme	Pepper	Curry	Monosodium glutamate
75	700	0.51	0.35	0.40	0.50	0.40	0.35

Sensory evaluation

Table 5 shows the sensory evaluation rating of beef patties prepared with and without *Ocimum gratissmum* extracts; In which the colour of beef in

treatment A (control) was found to be significantly (P<0.05) brighter than all other treatments, giving the highest mean value of 4.11. Treatment E had the lowest mean value of 3.08 (giving a dull colour). This implied that the longer the meat stayed in the extract (brownish-green) the more the deviation from the brightly cherry red and reflective colour observed in treatment A (control). The treatments B, C, D and E followed the trend of colour declination relative to time spent in the extract. This implied that the meat used absorbed the brownish-green colour of *ocimum* extract into the meat myofibrils. Furthermore, the colour of chevon patties of treatments B and C were rated higher than other treatments, this significantly (P<0.05) differed from all other treatments, giving the highest mean value of 6.89, while treatment E had the lowest mean value of 5.01after grilling. The colour of pork patties in treatments A, B and C were rated higher than treatments D and E which was significantly (P<0.05) lower than other treatments. The highest mean value of 6.61 was obtained in treatment A, while treatments D and E had the lowest mean values of 6.06 and 6.01 respectively.

Table 2. Proximate Analysis of *Ocimum gratissimum* leaves.

	%DM	%ASH	%C.P	%C.F	%E.E	%NDF	%ADF	%ADL
Leaves	24.68	10.00	13.30	10.00	6.00	55.0	36.00	11.0

Flavour Beef patties in treatments C and D with mean values of 4.99 and 4.81 were significantly (P<0.05) different from treatments A, B and E which ranked highest compared to other treatments but no significant (P>0.05) differences were observed between treatments A, B and E with mean values of 3.00, 3.11 and 3.06 respectively. This trend observed for flavour could be due to the chemotherapeutic effect of basil oil component eugenol/Methyleugenol (the active chemical component of *ocimum*) and groundnut oil during roasting which may have caused the breaking down of inosine monophosphate (MP) and hypoxanthine (ATP products) thus enhancing more pronounced flavour (Forrest, *et al.,* 1975).These results in a deposit of special flavor and aroma in the fat tissues of the meat soaked in the extract. Also, the flavour of chevon patties from treatments B C and D were significantly (P<0.05) different from treatment A and E with mean values of 5.33 and 5.26. No significant (P>0.05) differences were observed between treatment B, C and D while treatment E had the lowest mean value. As stated by (Moloney, 1999) flavour is influenced by the deposition of compounds from the feed in the fat of the animal which is the presence of monoterpene (methlyeugenol) and Sesquiterpenes (germacrene-D).While the flavour of the pork patties in treatments A, D and E had mean values that were significantly (P<0.05) different from treatment B and C with mean value of 5.44, 541 and 5.88.

Table 3. Proximate analysis of fresh meat types.

	%DM	%CP	%EE	%ASH
Beef	75.00	22.30	1.30	1.20
Chevon	75.70	21.40	1.20	1.60
Pork	75.10	22.80	1.80	1.20

Tenderness is described as the degree of toughness of meat. It is the ease with which the teeth sink into the meat when chewed (Omojola *et al.,* 2004). The trend for tenderness of beef and chevon patties in all the Treatments A, B C D and E significantly differed (P>0.05) across the row. The first impression of wetness produced by the release of fluid from the meat during the first few chews, and the second is the more sustained juiciness that apparently results from the stimulating effect of fat on the production of saliva and the coating of fat that builds up on the tongue, teeth and other parts of the mouth (Omojola

et al., 2004).While the trend of tenderness for the pork patties in all the treatments were in ascending order across the row that is the longer the meat stayed in the extract the more tender it became according to the statistical rating while treatment A was rated lowes.

Table 4. Proximate Analysis of beef, chevon and pork meat Patties cured with *Ocimum gratissimum* extract.

	%DM			%C.P			%EE			%ASH		
	Beef	Chev	Pork	Beef	Chev	Pork	Beef	Chev	Pork	Beef	Chev	Pork
TA	72.90	71.20	73.40	18.00	19.30	17.18	3.70	2.10	4.20	1.80	1.90	1.70
TB	71.11	71.06	73.11	18.01	18.06	18.91	3.60	2.17	4.31	1.91	2.01	1.89
TC	72.81	72.07	72.13	18.11	18.07	18.01	3.01	2.99	4.00	1.71	1.92	1.91
TD	70.99	73.01	71.14	19.90	16.09	18.72	2.89	2.99	4.01	2.21	1.89	1.81
TE	72.11	72.00	72.18	18.02	18.01	18.71	2.99	2.01	3.99	2.11	2.11	1.80

Juiciness in beef patties revealed that treatment A (control) had the highest mean value which was significantly (P<0.05) different from other treatments. Treatment E had the least mean value while treatment B and C were not significantly (P>0.05) different from each other. This connotes that the natural juiciness of meat is enhanced by moderately timing curing of the meat in *ocimum* extract but the longer it stayed the less juicy it became. There must have been strong interaction between intramuscular lipids and the moisture content of the meat during preparation and grilling, this enhanced juiciness of the beef patties from the uncured treatment (Hedrick *et al.,* 1994). According to (Moloney, 1999), meat juiciness is an important component of meat tenderness and palatability.

Table 5. Organoleptic évaluations of beef, chevon and pork meat patties cured with *ocimum. gratissimum* extract at different time interval (g/kg).

		TA	TB	TC	TD	TE	SEM
Beef	Colour	4.11^{a}	4.06^{ab}	4.00^{b}	4.00^{b}	3.08^{c}	0.30
Chevon		6.06^{b}	6.18^{a}	6.89^{a}	6.13^{b}	5.01^{c}	0.31
Pork		6.61^{a}	6.56^{a}	6.51^{b}	6.06^{c}	6.01^{c}	0.26
Beef	Flavour	3.00^{c}	3.11^{c}	4.99^{a}	4.81^{a}	3.06^{c}	0.34
Chevon		5.10^{b}	5.13^{ab}	5.33^{a}	5.26^{ab}	4.08^{c}	0.27
Pork		5.41^{a}	5.22^{b}	5.26^{b}	5.41^{a}	5.88^{a}	0.28
Beef	Tenderness	5.16^{b}	5.71^{ab}	5.86^{a}	5.91^{a}	5.79^{ab}	0.36
Chevon		6.87^{a}	6.70^{ab}	6.71^{ab}	6.77^{a}	5.11^{c}	0.28
Pork		5.22^{a}	5.11^{c}	5.21^{a}	5.16^{b}	5.18^{a}	0.33
Beef	Juiciness	4.95^{a}	4.87^{b}	4.77^{b}	4.49^{c}	4.02^{c}	0.33
Chevon		6.87^{a}	6.81^{a}	6.77^{ab}	6.01^{b}	5.02^{c}	0.31
Pork		6.03^{ab}	6.15^{a}	6.11^{a}	6.12^{a}	6.00^{b}	0.27
Beef	Texture	5.54^{ab}	5.57^{ab}	5.56^{ab}	5.81^{a}	5.07^{c}	0.33
Chevon		5.06^{b}	5.07^{b}	5.88^{a}	5.55^{b}	4.11^{c}	0.32
Pork		6.16^{a}	6.12^{b}	6.13^{b}	6.24^{a}	5.29^{c}	0.29
Beef	Overall Acceptability	6.74^{b}	6.81^{ab}	6.90^{a}	6.91^{a}	5.21^{c}	0.31
Chevon		6.96^{a}	6.11^{b}	6.79^{a}	6.80^{b}	5.99^{c}	0.33
Pork		6.70^{a}	6.26^{a}	5.89^{ab}	5.99^{ab}	5.55^{c}	0.30

^{abcd} – means on the same row with different superscripts are significantly (P>0.05)
Key: Trt A - Patties without OGE (control); Trt B- Pattie soaked in *OGE* for 30minutes; Trt C- Patties soaked in *OGE* for 1hr; Trt D - Patties soaked in *OGE* for 1hr-30minutes; Trt E - Patties soaked in *OGE* for 2hrs.

The juiciness of chevon patties showed that treatments B and C had the highest mean values and were significantly (P<0.05) higher than other treatments. Treatment E had the least mean value

and rated lowest in all the treatments. The trend of juiciness for pork patties showed that treatment B, C and D had the highest mean values which were significantly ($P<0.05$) different from treatments A and E. Treatment E had the least mean value while treatment B, C and D were not significantly ($P>0.05$) different from each other.

Texture The trend for texture in all the patties for all the treatments A, B C and D were significantly different across the row ($P>0.05$) except in treatment E which declined and the least value was recorded.

Overall Acceptability The overall acceptability of *ocimum* cured beef patties rating showed that Treatment A (control), B C and D were not significantly ($P>0.05$) different, though they had different mean values of 6.74, 6.81, 6.90 and 6.91 respectively.

Taste panel evaluation revealed that palatability characteristics of patties improved with increased curing time in *ocimum* extract. It could be inferred from this that the taste became more appreciated in patties cured for ½ hr and 1 hr in *ocimum extract* according to the rating of the panelist. However, the overall acceptability of *ocimum* cured chevon patties rating showed that Treatment A (control) and C were significantly ($P<0.05$) different from other treatments and were preferred, followed by treatment B and D which significantly ($p>0.05$) differed from treatment E which had the least mean value.

It could be inferred from this that the taste became more appreciated at ½ hr, 1hr and 1½ hrs of curing in *ocimum extract* according to the rating of the panelist. Finally, the overall acceptability of *ocimum* cured pork patties rating showed that treatment A (control) and B were not significantly ($P>0.05$) different but had different mean values 6.70 and 6.26. However, there were significantly ($P<0.05$) different from other treatments while treatment E had the least mean value with least acceptance. Taste panel evaluation revealed that palatability characteristics of patties improved with length of time soaked in *Ocimum* extract. This shows that there has been strong interaction between color, flavor, tenderness and juiciness for the patties. It is deduceable from this that the taste became more appreciated at ½ hr and 1 hr of curing in *ocimum extract* according to the rating of the panelist.

Conclusion

The curing activity of *ocimum gratissimum* extract evaluated on the organoleptic properties of meat patties of three meat types (beef, chevon and pork) at different soaking intervals revealed that.

Meat patties of beef and chevon cured with O*cimum* g*ratissimum* extract for 1 hr and 1½ hrs gave better overall acceptability.

While control and ½ hr cureded cured pork was preferred to patties from other curing times.

References

Abdulrahman AHN, Elhussein SA, Osman NA, Nour AH. 2009. Morphological variability and chemical composition of essential oils from nineteen varieties of basil (*Ocimum basilicum* L) growing in Sudan. International Journal of Chemistry Technology **1,** 1-10. http://dx.doi.org/10.3923/ijct.2009.1.10

Adeniyan ON, Ojeniyi SO. 2005. Effect of poultry manure and NPK 15:15:15 and combination of their reduced levels on maize growth and soil chemical properties African Journal of Food, Agriculture, Nutrition and Development **9(1),** 580-592 ISSN: 1684-5374 p.

Adeniyan ON, Ojo AO, Akinbode OA, Adediran JA. 2011, Comparative Study of different Organic manures and NPK fertilizer for improvement of soil chemical properties and dry matter yield of maize in two different soils. Journal of Soil and Environmental Management **2(1),** 9-13 p. Article number: 0573C6210248. ISSN : 2141-2391.

Alfard HN. 2009. Goat meat quality and its delicacy in New York Dietary Guidelines. American Heart Association. 23 January 2009. Retrieved 16 May 2010.

Douwe VD, Nico VB, Edzo V. 1997. Soil organic carbon dynamics: variability with depth in forested and deforested soils under pasture in Costa Rica Biology and Biochemistry **39(3),** 343-375 p. http://dx.doi.org/10.1023%2FA%3A1014203402176

Edeoga HO, Omosun G, Uche LC. 2006. Chemical composition of Hyptis suaveolens and Ocimum gratissimum hybrids from Nigeria. African Journal of Biotechnology **5(10),** 892-895 p. ISSN 1684–5315.

Effraim KD, Jacks TW, Sodipo OA. 2003. Histopathological studies on the toxicity of *Ocimum gratissimum* leave extract on some organs of rabbit. African Journal Biomedical Research 2003, **(6),** 21-5.

Esvanszhuga G. 1986. The Chemical Constituent of *Ocimum gratissimum*: DokiTskha **244,** 72-77 p.

EusufZai AK, Horiuchi T, Matsui T. 2008. Effects of green manure and Compost of pea plant with Chicken manure and Rapeseed oil residues on growth, yield and efficiency of Nutrient Uptake by wheat (*Triticum aestivum*) Compost Science.utilisation **16,** XX-XV.

Ezekwesili CN, Obiora KA, Ugwu OP. 2004. Evaluation of antidiarrhoeal property of crude aqueous extract of Ocimum gratissimum L. (Labiatae) in rats. Biokemistri **16,** 122-31. http://dx.doi.org/10.1186/1472-6882-13-101

FAO. 1990a. Manual of Simple Methods of Meat Preservation. Food and Agriculture Organisation Animal production and Health paper no. 79, Rome, Food and Agriculture Organisation. http://www.worldcat.org/title/manual-on-simple-methods-of-meat... Cached.

Fletcher A, Janet S. 2008. "Fresh goat meat finding favour on upscale menus" the San Francisco Chronicle **16,** 122-31.

Forrest JC, Aberle ED, Hedrick HB, Judge MD, Merkel RA. 1975. Principles of Meat Science, 1st Edition Kendall Hunt publishing WH Freeman and Co, San Francisco.

Fredrick A, Kunkle JO, Dwyer E, Timothy R 2004. Goat meat requires low-heat; slow cooking to preserve tenderness and moisture. Long an Ethnic Delicacy Goat does mainstream. The Washington Post. Retrieved May **3,** 2010.

Hedrick HB, Aberle ED, Forrest JC, Judge MD, Merkel RA. 1994. Principles of Meat Science, 3rd Edition Kendall Hunt publishing Co, Dubuque, Iowa. ISSN : 0975-7384.

Hyun TH, Barrett EC, Milne DB. 2004. Zinc intakes and plasma concentrations in men with osteoporosis: the Rancho Bernardo Study 23. American Journal of Clinical Nutrition ISSN 1684–5315.

Ijeh II, Omodamiro OD, Nwanna IJ. 2005. Antimicrobial effects of aqueous and ethanolic fractions of two spices, *Ocimum gratissimum* and *Xylopiaaethiopica*. African Journal Biotechnology 2005, **(4),** 953-6. http://www.ajol.info/index.php/ajb/article/viewFile/71128/60100

Iwu MM. 1996. Handbook of African medicinal plants. CRC Press Inc. Boca Raton, Florida, 1993. ISBN9781466571976.

Lawrie RA, Ledward DA. 2006. Studies on the effect of marbling in beef meat production in Europe Lawrie's Meat Science (7th ed). Cambridge: Woodhead Publishing Limited, 24-25 p. ISBN 978-1-84569-159-2. http://dx.doi.org/10.3923/jftech.2011.119.123

Mahendraker NS, Khabade VS, Dani NP. 1988. Studies on the effects of fattening and carcass characteristics and quality of meat from Bannun-lamb. Journal of Food Science Technology **25,** 228-230.
http://dx.doi.org/10.3923/jftech.2011.119.123

Moloney A. 1999. The quality of meat from Beef cattle-is it influenced by diet? In R and H Hall Technical Bulletin issue No. 4.

Oliver B. 1960. Medicinal Plants in Nigeria, Nigerian College of Arts, Science and Technology, Nigeria, 42-48 p.
http://dx.doi.org/10.5923.j.plant.20120201.08

Oliver B. 1980. Medicinal plants in Nigeria. Nigerian College of Arts, Science and Technology: lbadan 1980. African Journal of Traditional Complementary Alternative Medicine. 2007, **(2),** 191–198.
http://dx.doi.org/PMC2816451

Omojola AB. An assessment of "Suya" prepared from different muscle type", Nutrition and Food Science **39(3),** 277 - 282 p.
http://dx.doi.org/10.1108/00346650910957537

Raloff J. 2003. Beef culinary name for meat from bovine. Food for Thought Global Food trends Science News online. May 31, 2003.

Raloff J. 2003. Pork culinary name for meat from domestic Pig. Food for thought Global food trends Science News Online **6(34),** May 31, 2003 p.

Sofowara EA. 1984. Medicinal plants and traditional medicine in Africa: Spectrum Books Ltd. Ibadan, Nigeria, 55-56 P.

Statistical Analysis System. 1999. SAS Institute Inc. SAS/STAT™ Users Guide, Release 6.0 Ed, Cary, NC, SAS Institute Inc.

Venlauwe BJ, Diels NS, Meretaax R. 1998. Residue quality and decomposition. An unsteady relationship? In Driven by nature plant litter quality and decomposition. CAB International, Walligford, UK, 157-166 p.
http://dx.doi.org/10.1046/j.1365-2389.1998.