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Production and Chemical Analysis of Hand Sanitizer Produced from Garlic, Aloe Vera and Ethyl Alcohol for Family Use

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Abstract

The study produced and analysed hand sanitizer made from garlic (Allium Sativum), aloe vera (Aloe Barbadensis Miller) and ethyl alcohol for family use and income generation. It was an experimental research. Three research questions were raised to generate answers for the study. The major findings of the study among others include identification of materials for the for production of local hand sanitizer using local raw materials; garlic, aloe vera, 30% alcohol and other inactive additives, hand sanitizer was produced using local raw materials. The chemical analysis performed to determine the sanitizing properties showed that the hand sanitizer produced had the characteristics of a good hand sanitizer. The following recommendations among others were made; copies of the findings of the study should be made available to researchers to read and gain additional knowledge on other local raw materials that have antibiotic effects for producing hand sanitizers. The production of locally made hand sanitizers should be encouraged instead of relying on the importation of foreign products. The government should encourage unemployed graduates by providing soft loans to enable them to establish cottage industries that will be producing hand sanitizer using local raw materials.

Keywords: Production, Hand sanitizer, Garlic, Aloe vera, income, family use

Introduction

Most Nigerian families, despite their level of education and exposure, still do not practice proper hygiene as it is expected to curb infection and food contamination. This seems to contribute to poor health conditions being experienced in various homes

and communities today. In order to curb the spread of bacteria related diseases, good personal hygiene that requires regular hand washing after every activity is needed. Hygiene means proper cleanliness of oneself and its surroundings to prevent the spread of diseases. Hygiene is of great importance in the prevention of many kinds of infections, for example infections of the gut, the skin, the eye, the lungs and the whole body. Many infections of the gut are spread from one person to another because of poor hygiene. Washing of the hands regularly reduces to the barest minimum the increase of the germs in human hands. Effective washing of hands require the use of soap and good water. This may however not be available at all times; hence hand sanitizer becomes a veritable alternative for cleaning hands when soap and water are not available. Using hand sanitizer that can easily be carried along, will go a long way in not only killing germs and bacteria in our hands, but will minimize the transmission of germs.

The importance of hygiene in the world today is quite significant to human survival. Seeing the havoc caused by the outbreak of diseases in recent times, the worst of these diseases was the outbreak of Ebola virus in 2014. In the year, 2014 Nigerians witnessed an era of outbreak of Ebola virus, which claimed many lives before it was put under control. During the Ebola period, the major emphasis was the cleaning of hands with hand sanitizers as a form of control. This brought to lime light the need and necessity for frequent cleaning of hands with hand sanitizers to prevent the spread of micro- organisms.

Hand sanitizer is a liquid substance that is applied by rubbing it on hands to kill germs. U.S Department of Health and Human Services (2016) further stated that hand sanitizer is effective hand cleaners that kill germs and bacteria. The chemical component of typical hand sanitizers is made up of active and non - inactive additives. The active ingredients in a typical hand sanitizer is ethyl alcohol while other inactive additives such as tricosan,, sodium lauryl, ether sulphate, aqua, sodium chloride, citric acid, cocamide, diethanolamine, colour preservative, propylene glycol and essential oil of plants and fragrances (Center for Disease Control and Prevention, 2016). Alcohol is one of the active ingredients in producing hand sanitizer, has been known to kill germs hence; it is used to destroy germs in a body environment before introducing an injection into the patient's body and also cleaning up a body surface before an operation (Yeh, Eisenberg, and Philips 2003, Watkins, Chriwaterguy and Joshua 2012). Stressing further, Sherwood (2013 and Rogers 2015) noted that hand sanitizer with at least a 60 percent inclusion of alcohol are effective in killing bacteria, including the Streptococcus bacteria,

as well as the bacteria that cause tuberculosis.

There are other active ingredients that can be used in producing hand sanitizer. They are plant extracts - garlic (*allium sativum*) and Aloe Vera (*aloe barbadensis miller*). Garlic and aloe vera are one of the earliest documented plants used by human for the treatment of diseases and maintenance of health (Natural Health Publications 2010 and Food, Drug and Administration (2014). Aloe Vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The chemical components of hand sanitizer produced using local agricultural materials are garlic, aloe vera and 30% ethyl alcohol as the active ingredients with other inactive additives such as treated water, carbopol, triethanolamine, glycerine , frangrance, and colouring.

The typical hand sanitizer must possess certain antiseptic properties such as the ability to kill germs, that is, it has to be anti – bacteria, anti - fungal and anti – viral properties. In fact, it must have ability to control various species of ill - causing micro-organism. According to Safespace (2017) a typical hand sanitizer must possess certain antiseptic properties such as ability to kill germs, active and stable, safe for people and animals, environmentally safe, leaves no damage or corrode faucets beyond recognition, affordable, dry quick and must have detailed instruction for proper usage. Aloe–Vera, garlic extracts and alcohol can kill micro organisms by denaturing their proteins and dissolving their lipids and so were all effective against bacteria, fungi and viruses. The hand sanitizer produced from garlic, aloe vera and 30% ethyl alcohol has all the above sanitizing properties of a typical hand sanitizer as it was subjected to test and was found to be very effective in denaturing many micro organisms tested, it was found to be safe, cheaper, effective and dries up quickly. It would enable families to prevent the spread of diseases and infection for healthy living and would aid in income generations by family members.

The hand sanitizer produced have inhibitory action on fungi, bacteria and viruses Productions of local hand sanitizer will ensure prevention of diseases and infections but unfortunately observations and studies have revealed that most of the hand sanitizers used in the country are imported and as such they are very expensive to buy. The production of local hand sanitizer will involve using agricultural materials such as ethyl alcohol, garlic and aloe vera to generate the necessary anti biotic effects for tackling the spread of diseases.

The roles hand sanitizers played in preventing the spread of Ebola disease increased the demand of hand sanitizers in the market. Most hand sanitizers used in Nigeria at this period were imported and were quite expensive and scarce. The need to

produce hand sanitizer using locally agricultural materials that will be more effective, cheaper and available to curb the spread of diseases has led to this research, Therefore combining ethyl alcohol, garlic and Aloe Vera in producing hand sanitizer will have more effective control of various species of germs and viruses in the body, considering the properties of the two raw materials (garlic and aloe vera). The production of hand sanitizer will take care of volumes of the products that will be used by the populace.

The Objective of the Study

The general objective of the study was to produce and test hand sanitizer from locally available materials for family use and income generation.

Specifically, the study:

1. identified locally available materials for production of hand sanitizer,
2. prepared hand sanitizer from locally available materials,
3. tested the hand sanitizer (chemical analyses).

Methodology

***Design of the study*:** The study was an experimental study. It involved the following steps:

Procurement of materials (active and non active) ingredients

The following materials were procured:

Garlic	700g
Aloe vera leaves	700g
Ethyl alcohol	1.5 litres
Activated carbon	400g
Treated Water	2.5 litres
Thickner (Carbopol 940)	15g
Triethanolamine (neutralizer)	20 ml
Glycerin (moisturizer)	10 ml
Fragrance	12 ml
Colour	to taste (optional)

Procedures for the Preparation of Garlic Juice (Extraction): The following procedures were evolved in the extraction:

i. A sizeable amount of garlic was purchased from the market, out of which 700g was weighed, peeled and washed in deionizer water.
ii. 419g was weighed out of it, then grinded using newly purchased electric blender to avoid contamination.
iii. The mixture was poured into mixing bowl, this was followed by the addition of 0.75 litres of alcohol, this was mixed together by stirring and left for 20 minutes for maximum extraction
iv. The mixture was sieved in a 40-mesh sieve of 0.420mm opening to filter and separate the solid particles from the extract
v. The extract was passed through an activated carbon column to remove the odour and colour of garlic to a reasonable extent. The odour was a bit offensive while the colour was a light cream colour.
vi. At this point the resultant premix was 0.85 litres of the garlic extract ready for use.

Procedure for the Preparation of the Aloe Vera gel (Extraction)

i. A sizeable amount of aloe vera was purchased from the market, washed, out of which 700g was weighed using a weighing balance.
ii. This was peeled to remove the green colouring matter leaving the gel and weighed to obtain. 480g.
iii. It was grinded with the use of an electric blender and pour into mixing bowl
iv. 0.75 litres of alcohol was added, mixed together and left for about 20 minutes for maximum extraction
v. The mixture was sieved in a 40-mesh sieve of 0.420mm opening to filter and separate the solid particles from the extract
vi. The extract was passed through an activated carbon column to remove any possible odour and the green colouring matter to a reasonable extent.
vii. At this point the premixed which were 1.1 litres of the aloe vera extract ready for use.

Procedures for the Formulation of Locally Made Hand Sanitizer

A large plastic bowl of about 10 litres was obtained and cleaned properly.

2.5 litres of treated water was poured into the cleaned bowl, Fifteen (15) grammes of thickner (Carbopol 940) was added to the treated water and left for 24 hours to dissolve properly, it was stirred to obtain a homogenous mixture. This was followed by the gradual addition and simultenous stirring of trietholamine to turn the mixture into a semi viscous gel. This was followed immediately by gradual addition and stirring of glycerine to remove any lumps that might have been formed and to achieve a homgenos mixture. The premixed Aloe vera extract and garlic extract were added to the resulting homogenous mixture with continous stirring in a clock wise direction to entrap more air for the formation of bubbles on the hand sanitizer. Fragrance was then added to produce a desirable odour.

Little quantity of colour (if required) which has been dissolved in 5ml of treated water was added to the resulting hand sanitizer to enhance the aesthetic value of the product. Finally, the resulting hand sanitizer was then poured into 60 pieces of 80ml of properly labeled containers.

Findings

Procedure for the Chemical Analysis:

To find out the chemical analysis, the following were determined:

Determination of Ash Content

Ash determination was carried out according to AOAC (2010) procedure. Two grams of sample was placed in silica dish which had been ignited, cooled and weighted. The dish and sample were ignited first gently and then 550^{o}C in a muffle furnace for 3 hours, until a white or grey ash was obtained. The dish and content were cooled in a dessicator, and weighed.

$$\% \text{ Ash} = \frac{(W_3 - W_1)}{(W_2 - W_1)} \times \frac{100}{1}$$

Where

W_1 = weight of dish
W_2 = weight of dish + sample before ashing
W_3 = weight of dish + sample after ashing

Determination of Fat

The fat content was determined according to AOAC (2010) soxhlet extraction method. A 500ml capacity round bottom flask was filled with 300ml petroleum ether and fixed to the soxhlet extractor. Two grams of sample was placed in a labeled thimble. The extractor thimble was sealed with cotton wool. Heat was applied to reflux the apparatus for six hours. The thimble was removed with care. The petroleum ether was recovered for reuse. When the flask was free of ether it was removed and dried at 105°C for 1 hour in an oven. The flask was cooled in a dessicator and weighed.

Calculation:

$$\% \text{ fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times \frac{100}{1}$$

Determination of Crude Fibre

Crude fibre was determined using the method in AOAC (2010). Three (3) grams of the sample was weighed into a 50ml beaker and fat was extracted with petroleum ether by stirring, settling and decanting three times. The extracted sample was sir dried and transferred to a 600ml dried beaker. Then 200ml of 1.25% sulphuric acid and few drops of anti-foaming agent were added to the beaker. The beaker was placed on digestion apparatus with pre-adjusted hot plate and boiled for 30 minutes, rotating beaker periodically to keep solid from adhering on the sides of the beaker. At the end of 30 minutes period, the mixture was allowed to stand for one minute and then filtered through a Buchner funnel. Without breaking suction, the insoluble matter was washed with boiling water until it was free of the acid. The residue was washed back into the original flask by means of wash bottle containing 200ml of 1.25% sodium hydroxide solution. It was again boiled briskly for 30 minutes with similar precautions as before. After boiling for 30 minutes, it was allowed to stand for one minute and then filtered immediately under suction. The residue was washed with boiling water, followed by 1% hydrochloric acid and finally with boiling water until it was free of acid. It was washed twice with alcohol and then with ether for three times. The residue was transferred into ash dish and dried at 100°C to a constant weight. Incineration to ash was done at 600°C for 30 minutes, cooled in a desiccator and weighed. The difference in weight between oven dry weight and the weight after incineration was taken as the fibre content of the sample. This was expressed as a percentage weight of the original sample taken for analysis.

$$\text{Crude Fibre (\%)} = \frac{\text{Oven dried sample} - \text{Weight of sample incineration}}{\text{Weight of sample taken}} \times 100$$

Table: Shows the chemical Analysis of hand Sanitizer Produced and Result

LAB NO	SAMPLE	% DM	% MC	% CF	% FAT	% ASH
1	HS	0.80	99.20	0.001	1.32	0.99
		0.80	99.20	0.002	1.30	0.96
		0.82	99.18	0.001	1.30	0.96
2	CHS	1.00	99.00	0.002	1.32	0.99
		0.82	99.20	0.001	1.31	0.97
		0.91	99.09	0.001	1.30	0.99

Key DM: Dry Matter, MC: Moisture Content, CF: Crude Fibre, ASH: Ash Content

The result shows the percentage moisture content of the hand sanitize observed in the table range from 99.18 to 99.20 and did not differ significantly from the control which range from 99.00 to 99.20. The percentage crude fibre, fat and ash content of the hand sanitizer as observed in the table range from 0.001 to 0.002, 1.30 to 1.32 and 0.96 to 0.99 respectively and did not also differ significantly from the control which range from 0.001 – 0.002, 1.30-1.32 and 0.97 – 0.99 respectively.

The following findings were made from the study. This includes:

- Hand sanitizer was formulated using locally sourced materials garlic, aloe vera, 30% alcohol and other inactive additives
- A recipe of hand sanitizer was made from extracted garlic and aloe vera using 30% alcohol.
- The chemical analysis show that the hand sanitizer produced from local raw materials have good sanitizing properties such as ability to kill germs, active and stable, safe for people and animals, environmentally safe, leaves no damage or corrode faucets beyond recognition, affordable ,dry quick and must have detailed instruction for proper usage. In fact, it must have ability to control various species of ill - causing micro-organism.

Discussion of Findings

The study shows that hand sanitizer can be produced from locally material (garlic, aloe vera, 30% alcohol with other inactive ingredients such as treated water, thickner, triethanolamine, glyerine, fragrance and colour). From the above, it can be seen that the use of garlic, aloe vera as the active ingredients are derived from the fact that, garlic and aloe vera have anti microbial, anti fungal and anti bacterial properties that can attack the effect of micro organism (National Research Institute 2010 and Saini 2016). Plant extracts *(Allium Sativum* and Aloe *Vera barbadensis miller)* are viable part of the active ingredients in the hand sanitizer utilizing the anti bacterial properties of these plants. From the above, it can be deduced that garlic for the production of hand

sanitizer must be processed to obtain garlic juice for use and it is very essential ingredient for the production of local hand sanitizer because of its healing properties. The use of garlic juice has since been recognized by man all over the world as a valuable condiment for flavouring of various vegetarian and non- vegetarian dishes. Aloe vera gel is also produced in a similar way From the above, it can be deduced that aloe vera leaf must be processed to obtain aloe vera gel for use and it forms essential ingredient for the production of local hand sanitizer because of its healing properties. Aloe vera has since been recognized by man all over the world as valuable ingredients for maintenance of health and treatment of diseases. Garlic and Aloe vera are usually extracted with alcohol and deodorized before using them in the formulation. The findings of the study with regards to the production of hand sanitizer made from local raw materials (garlic, aloe vera and 30% alcohol) showed that hand sanitizer can be locally produced from garlic, aloe vera, 30% alcohol with other inactive ingredients. The extraction of garlic and aloe vera is in line with the findings of Singh and Singh (2008) who noted that garlic has since long been recognized all over the world as a valuable condiment and a popular remedy for various ailments and physiological disorders. *Allium Sativum* and *Aloe Barbadensis Miller* are one of the earliest documented plants used by man for the treatment of diseases and maintenance of health; they all have inhibitory action on bacteria, virus and fungi. This inhibitory action is in consonant with the findings of Food and Drug Administration (2014) which noted this antiseptic effect; that aloe Vera contains 6 antiseptic agents: Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulphur. Ezeoguine (2015) noted that home Economics encourages the expansion of knowledge and development of skills in many areas. Production of hand sanitizer is very essential for skill development in Home Economics related areas.

The result shows the chemical analysis of the hand sanitizer produced, the crude fibre is negligible, whereas the ash and fat content are significantly low on the contrary, its content was significantly high hence, low dry matter. It implies that when the hand sanitizer produced is applied on the hand, there will be no friction. That is, the hand sanitizer produced is smooth and safe to be used. The fat content tested was not gumming that is, it can dry quickly when applied. This is in line with the findings of Safespace (2017) who noted that a typical hand sanitizer must possess certain antiseptic properties such as ability to kill germs, active and stable, safe for people and animals, environmentally safe, leaves no damage or corrode faucets beyond recognition, affordable ,dry quick and must have detailed instruction for proper usage.

Recommendations

Based on the findings of this study, the following recommendations were made:

- ❖ The findings of this study should be made available to individuals, families, future learners, researchers, consumers in all works of life through organizing seminars and workshop at the local and state government levels to educate the public on the importance of producing and using hand sanitizer made from local raw materials.
- ❖ The manufacturers of hand sanitizer should continually engage in more research to update themselves on other ways of improving their products.
- ❖ Hand sanitizers should be developed using available local materials instead of relying heavily on the importation of foreign products.
- ❖ The government should encourage the unemployed graduates by providing soft loans to enable them to engage in small scale production of hand sanitizer using our local raw materials.

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