Original Research Article

Production and Consumer Acceptability of Eco-Friendly Household Cleaning Products from Locally Available Materials

Abstract

Household cleaning products are commonly used worldwide to enhance cleanliness and hygiene. Most household cleaning products marketed commercially today are very expensive, unaffordable and contain toxic and harmful chemicals. Some may even damage the cleaned surface through corrosion or abrasion. The aim of this study was to produce eco-friendly household cleaning products from locally available materials. The study was carried out in Omuku, Rivers State. The population was made up of all 182 housekeepers and working mothers across the five school of the Federal College (Technical) of Education and 15 hotels. The stratified random sampling technique was used to sample 102 working mothers and housekeepers. Household cleaning products such as liquid soap was produced from local materials such as orange, lemon, tangerine, coconut oil, and palm ash. Toilet cleaner was formulated from ginger and aloe vera extracts and activated carbon while floor wash was made from local gin, liquid wash, alcohol, lemon and sodium chloride. The products were subjected to sensory acceptability. A nine Point Hedonic Scale questionnaire was also constructed and administered to the respondents for data collection. Mean rating was used to analyze the research questions and sensory evaluation and Z-test was used to analyze the hypotheses at 0.05 level of significance. The result of the study revealed that the locally produced household cleaners were acceptable in terms of quality. The respondents' response differed with respect to the colour and the odour of locally made household cleaners especially the locally produced liquid soap. The study also revealed that the locally produced household cleaners differed from commercial ones only in terms of colour. The result therefore indicates the potentials of utilizing locally available materials for the production of non-toxic, natural and environmentally safe household cleaning products.

Keywords: Household, cleaning products, eco-friendly, local materials, acceptability

1. INTRODUCTION

The term 'household' refers to a group of people living together in a common residence or apartment as consuming units in a physical environment [1]. A clean household is important for a healthy life and quality living. Beside food, sleep and clothing, cleanliness is a key and essential factor in family living; as a result the most common routine practice in all society is cleaning the house and surroundings in the morning. In traditional society, the cleaning materials were so simple such as branches of trees, palm frond, pawpaw leaves, salt, ashes, lime, palm kernel oil, bee-wax and Shea butter among others or a combination of two or three. The advent

of commercial cleaning agents gradually eroded our cleaning prowess in household and environmental hygiene. This is evident for state and national sanitation to re-awaken Nigerians to practice basic household and environmental hygiene. More observation and interactions shows that most households and environment that are dirty are blamed on economic down-turn of the families in respect of living wages and hectic life-style of urbanization. Maintenance and care of the home are very important activities in home management because the activities involved improve the overall health and wellbeing of family members. Maintenance and care of the home involves cleaning equipment, tools and cleaning agents for cleaning different surfaces and other areas of the home.

Household cleaning agents are substances used to dissolve/remove dirt from the surface of articles, items, tools, furniture and equipment, etc. They are regularly and commonly used worldwide for the enhancement of cleanliness and hygiene at the household level [2]. These products are formulated to efficiently and conveniently clean surfaces in the household. Household cleaning agents are what modern homemakers/housekeepers use in keeping household articles/items clean and make them last longer. The reason for cleaning household articles/items is to enable them look neat, adorable and comfortable for living. When these articles are cleaned, cleanliness is maintained in the home [3].

Household cleaning products can be classified either as all purpose cleaners or specific surface cleaners. Some of these all purpose cleaners could include abrasive cleaners (powdered cleaners, liquid cleaners and Scouring Pads) and non-abrasive cleaners (powdered or liquid cleaning agents mixed with water and spray cleaners). The specialty cleaning products are designed for specific surfaces such as glass, bathroom surfaces, ovens, drains, metal floors, etc. These could either be bleaches, disinfectants, hard water mineral removers, metal cleaners, polishes, etc. They can deliver optimum performance and convenience. These cleaning products are necessary for household hygiene. However, they may contain chemicals that may be toxic and even carcinogenic. Some of these products have potentials to clean surfaces but on the other hand damage the cleaned surface through corrosion or abrasion. The long term effects of chemical exposure from cleaning products are on the increase. Maisey [4] reported that long term exposure of these cleaning products can be associated with cardiovascular hazards including heart stress through exposure to chemical products and air fresheners. The author also stated that there are over 250, 000 children treated for chemical exposure as the result of exposure to these cleaning products in the home each year in the US (1990-2006). There is a need to look out for cleaning products that are non-toxic and environmentally safe. It is based on the health hazard that the researcher decided to seek alternatives using local materials to produce household cleaning products so as to reduce health hazards that could come from the commercial cleaning agents.

Recently, consumers' awareness on the use of eco-friendly and green cleaning products is on the increase. The term 'eco-friendly' or green cleaning products are products which contain environmentally safe ingredients either used alone or in combination with other ingredient for household applications. They are used to clean surfaces naturally, without any unpleasant

chemical residue. These cleaning products are sold and marketed as being environmentally safe. Plant extract from thyme plant referred to as Thymol has been used as a green disinfectant [5]. It is also reported to kill 99.99% of microbes and marked as a safe, botanical alternative to other chemical cleaning agents such as ammonium compounds and sodium hypochlorite. There is a need to develop cleaning products from natural raw materials which are locally available as these natural products readily react under normal household conditions to form harmful secondary pollutants.

Hygiene and optimum cleanliness have become the basis of ensuring that infection and contagious diseases do not infect homes and cause an epidemic. Part of the celebrated tragic disease spread in this decade such as cholera, diarrhea, typhoid, lassa fever, zika virus are attributable to dirty households and surroundings. The sole preventive measures being promoted is cleanliness and hygiene. Cleanliness is the main concern in health advocacies. Unfortunately this is lacking in most homes because most of the cleaning agents are commercially made and are very expensive and unaffordable for most homemakers/housekeepers. Homemakers spend a lot of money in purchasing household cleaning agents which could be utilized for other things in the family. Reduction of this expenditure will enhance economic well-being in the family as well as promote good health. It is therefore important to innovate by modifying basic methods and developing products with locally sourced materials and other natural products such as coconut oil, rough lemon, Ginger, Aloe-Vera, cone ash, egg shell, orange rinds etc. These materials contain antimicrobial properties. Hence, the researcher intends to use them as active ingredients in producing household cleaning products such as toilet wash, floor wash and liquid wash. This study is conceived from the fact that home is the primary abode for socialization and there is need to ensure absolute cleanliness and hygiene that will guarantee sustainable wellbeing. The study therefore aimed at producing eco-friendly household cleaning products from locally sourced materials for clean and sustainable family living and also determining the consumer acceptability of the products.

2. MATERIALS AND METHODS

2.1. Design of the Study

The study was carried out using an experimental research design and survey.

2.2. Area of Study

The study was carried out in Omoku, the head quarter of Ogba, Egbema, Ndoni Local Government Area of Rivers State, Nigeria. Omoku is situated in the Northern part of the State. People from Omoku are referred to as Ogba People. Rivers State, also known simply as Rivers, is one of the 36 states of Nigeria. According to census data released in 2006, the state has a population of 5,185,400, making it the sixth-most populous state in the country. Its capital, Port Harcourt is the largest city and is economically significant as the center of Nigeria's oil industry. Rivers State is bounded on the South by the Atlantic Ocean, to the North by Imo, Abia and Anambra States, to the East by Akwa Ibom State and to the West by Bayelsa and Delta States. It is home to many indigenous ethnic groups: Ikwerre, Ibani, Opobo, Ekpeye, Eleme, Okrika, Kalabari, Etche, Ogba, Ogoni, Engenni, Obolo and others. The people from Rivers State are known as "Riverians"

Omoku is home to the indigenous people of Ogba Kingdom, whose language is Ogba Language. Ogba Language is a dialect of the standard Igbo spoken by the Ogba people of Nigeria. It is generally known as one of the" Igboid" languages.
The socio-cultural situation in Omoku could be described as homogenous: it is mostly populated by the Ogba People, who can be found literally in all part of Omoku. Ogba people have continued to maintain ethnic identity. Christianity is a long history with Ogba people and inter-marriages have continued to bind them together
The Economy of the Ogba people is largely characterized by formal sector activities with oil Production, mining ,drilling and hotel management and services as the major economy activity, over 70% of the population are engaged in farming, fishing, trading, hunting and production of household items(i.e. native baskets (ekite) and native soap (ncha ogba)). Ogba people are one of the highest producers and users of Native soap in Rivers state, Nigeria [6]. This led to the study being conducted in the above area.

2.3. Population of the study

The population was made up of all 182 housekeepers and working mothers in Ogba/Egbema/Ndoni Local Government Area of Rivers State. The study spanned across the five (5) schools that made up Federal College of Education (Technical) Omoku and fifteen (15) hotels in Omoku [7]. The population consist of hundred and thirty seven (137) working mothers in the five schools that made up Federal College of Education (Technical) Omoku and forty five (45) housekeepers in the 15 hotels in Omoku.

2.4. Sample and Sampling Techniques

The sample size of the study was made up of hundred and forty two (142) working mothers and Housekeepers. The Sample size was derived using Taro Yamane formula [8]. The sample technique used for the study was stratified random sampling technique. This technique was employed to select 102 panelists of working mothers from the 5 schools of Federal College of Education (Technical) Omoku (Business Education, Vocational Education, Primary Education, Science Education and Technical Education). These mothers were chosen because they are homemakers and they utilize household cleaners mostly. Also 40 housekeepers from the fifteen (15) various hotels were also selected; the total sample size was 142 panelists from both FCE (T) and the hotels in Omoku.

2.5. Production of Local Liquid soap

Materials/Equipment: Orange, lemon, tangerine, coconut oil and palm cone ash were purchased from village market in Omoku, Rivers State. Other equipments used were wooden spatula, cooking pot, fire wood, 20 litre gallon, weight scale, sieve, electric blender and basin (stainless).

Procedure:

The citrus fruits were washed and cleaned with a kitchen towel. It was thereafter peeled and the rinds gathered. The rinds were sun-dried for about 2 weeks until they were hard dried and then milled to powdery form. The milled rinds were sieved to smooth powder. Palm cone was burned to ashes, dissolved with water and then drained in a padded sieve. The sieved rind powders were mixed with water and sieved. The sieved water from the rinds was added to the ash solution. The both solutions were poured into a cooking pot and boiled for 4 hrs with 500 ml of coconut oil

added. The pot was placed on a lighted firewood and fried for 1 hr. The fried sample was then poured into 3 L of water and stirred thoroughly until mixture or soap became light as desired (if too thick add more water as desired). The mixture was then poured into a container for further use.

Table 1: Recipe for the production of locally made liquid wash

Ingredients	Quantity
Palm cone ash	**500 g**
Water	**5 L**
Orange rinds	**100 g**
Lemon rinds	**100 g**
Tangerine rinds	**100 g**
Coconut oil	**500 ml**
Lemon roughage	**50 g**

2.6. Production of Toilet Cleaner

Materials/Equipment: Ginger, Aloe vera, Electric citrus extractor, weighing machine, electric blender, 3 bowls, sieve, stirrer, knife, 4 litre jerry can and activated carbon (400 g).

Procedure:

Extraction of ginger juice

Ginger rhizomes (700 g) was peeled and washed in clean water. Thereafter, it was weighed and blended using an electric blender. It was then poured into a mixing bowl and 500 ml of alcohol poured into it. The mixture was allowed for 30 mins for maximum extraction, sieved to filter and then the solid part separated from the extract. This gave 1.1 L of ginger juice extracted.

Extraction of Aloe Vera Gel

Aloe vera leaf (700 g) was peeled to remove the green part leaving the gel. The gel was weighed and 480 g obtained. The gel was thereafter blended using an electric blender. The gel was poured into a mixing bowl and 500 ml of alcohol added into the mixture for maximum extraction of the juice. This was followed by sieving resulting to 0.85 L of aloe vera extract.

All the ingredients used produced 2 litres, and then 1 litre of lemon juice was poured into a basin. The Aloe Vera gel and ginger juice extracted were poured into the basin containing the lemon juice thereafter all the items were thoroughly mixed together, and was poured into a gallon which was ready for use. The above mixture gave 3 litres of toilet cleaner.

2.7. Production of Floor Wash

Materials/Equipments

- Weighing machine
- Electric blender
- Wooden spatula
- Bowl
- Sieve
- Knife

- Funnel
- 5 litre gallon
- Spray bottle
- Hand glove
- ½ yard of calico hand towel
- Local gin
- Lemon (3 kg)
- Alcohol (200 ml)
- Sodium chloride (200 g)
- Liquid soap (200 ml)
- Water (1 L)

The local gin was bought from local gin sellers in Omoku market in Rivers State. Lemon was bought from village market in Omoku Rivers State. The local liquid soap was produced by the researcher in the Biochemistry laboratory in Michael Okpara Federal University of Agriculture Abia State. The procedure was written in the production of local liquid soap. The salt was bought at Ahiaeke in Umuahia in Abia State

Procedure

Three kilograms (3 kg) of lemon was weighed. Calico hand towel was washed and dried. The lemon was also washed with clean water and peeled. After peeling, it was weighed again and 2½ kilos obtained. Lime was cut into two (2) equal half and the juice was pressed out into a mixing bowl. The juice was sieved to remove the seeds and other particles in order to obtain a clear juice. The roughage was cut into tiny pieces and poured into the electric blender in stages and blended with the local gin. After blending all the lemon roughage, it was kept for 30 mins. It was then poured into a basin with the calico spreads over the basin. The calico containing the lemon roughage and gin was squeezed to get the remaining juice out of lemon. All the juices were mixed together into another basin. Two hundred grams (200 g) of salt was dissolved into the juice followed by 200 g of liquid soap which was poured into the mixture and thoroughly stirred for 15 mins to achieve a uniform mixture. The mixture was weighed and 2 litres was obtained. The mixture was poured into two spray bottles of 1 litre each using the funnel and the spatula. The bottles were tightly covered and kept for further use.

Figure 1: Locally produced floor wash (A), locally produced liquid soap (B), locally produced toilet wash (C)

2.8. Instrument for Data Collection

A nine Point Hedonic Scale questionnaire was constructed by the researcher for data collection. The questionnaire was used to obtain data on the effectiveness of recipe used in the production of household cleaners. The questionnaire was titled "Production and consumer acceptability of eco-friendly household cleaning products from locally available materials Questionnaire".

The questionnaire was divided into two sections, namely A and B; Section A is the socio economic characteristics of the respondents such as gender and occupation. Section B comprised of items used in the production of household cleaners. The questionnaire contained 20 items, which measured the independent variable.

The data were assessed using nine point hedonic scale of

9 - - - Extremely High extent (EHE)

8	-	-	-	Very High Extent (VHE)
7	-	-	-	High Extent (HE)
6	-	-	-	Slightly High Extent (SHE)
5	-	-	-	Slight Low Extent (SLE)
4	-	-	-	Moderately Low Extent (MLE)
3	-	-	-	Low Extent (LE)
2	-	-	-	Very Low Extent (VLE)
1	-	-	-	Extremely Low Extent (ELE)

2.9. Validation of the Instrument

The instrument was face validated by three experts in Home Science/Hospitality Management and Tourism in Michael Okpara University of Agriculture Umudike and two lecturers at Federal College of Education (Technical) Omoku.

2.10. Reliability of Instrument

The instrument was tested with five (5) house keepers from hotels in, Obio Akpor Local Government Area, Port Harcourt, Rivers State, Nigeria and fifteen (15) working mothers from University of Port Harcourt, Rivers State, Nigeria which were not part of the study in order to determine the internal consistency of the instrument. Cronbach Alpha method was used to analyze the reliability of the instrument and the reliability coefficient of .831 was achieved. Which shows the instrument was very reliable.

2.11. Administration of Data Instrument

The researcher administered the instrument with the help of two (2) research assistants. The products formulated were given to panelists to use at home to see if they like it while they respond to the instrument and returned within (3) three days to the researcher.

2.12. Sensory Evaluation

Twenty panelists consisting of male and female students of Federal College of Education (Technical) Omoku were used for the sensory evaluation of the attributes quality, color, odour and general acceptability to assess the samples. Mean rating was used to analyze the sensory evaluation.

2.13. Method of Data Analysis

Data collected from questionnaire were subjected to statistical analysis using Starta. Data collected were edited, coded and then entered into STARTA data editor. STARTA was used to make summaries of data in a way that provided answers to research questions. The software also provided assistance in the generation of tables, and pool mean. Analysis of data from the questionnaire responses involved the process of restructuring data into a form that allowed patterns to be identified. This was done by using content analysis in excel. This strategy (content analysis) involved grouping the respondent's answers into related themes. Mean rating was used to analyze the research questions and sensory evaluation and Z-test was used to analyze the hypotheses at 0.05 level of significance. The findings from the analysis helped to draw conclusions on the subject matter.

2.14. Decision Rule for Accepting or Rejecting the Above Stated Hypotheses, and Research Questions.

Any mean rating greater than 5.0 was accepted whereas any mean rating equal to or less than 5.0 was rejected for the research question and sensory evaluation. For the hypotheses any z value <= 1.68 was accepted whereas any z value greater than >1.68 was rejected. The bench mark to decide the wideness of disparity in agreement of responses was 1.50. If S.D <1.5 disparity is not wide, but if S.D >= 1.5 then disparity is wide

3. RESULTS

3.1. Consumer Acceptability of Toilet wash produced from locally available materials

Table 2 shows the mean sensory scores of eco-friendly toilet wash produced from locally available materials. From the table above, it was observed that the pooled mean of respondents was 6.92 which exceeded the decision rule of 5.00 indicating that the respondents liked the locally produced toilet wash to a slightly high extent. The standard deviation of 1.40 which is less than the bench mark of 1.50 showed that the disparity in agreement was not wide, which simply means majority of the respondents accepted the characteristic of the toilet wash which was made up of the colour, foaming, odour and quality

Table 2: Mean Sensory Scores for toilet wash

Items	X	SD	Remark
Colour	6.55	1.82	Slightly high extent
Foaming	7.45	0.99	High extent
Odour	7.15	1.56	High extent
Quality	6.45	1.53	Slightly high extent
Acceptability	7.00	1.12	High extent
Pooled Mean	**6.92**	**1.40**	**Slightly high extent**

Keys: *X=Mean Response of respondents SD= Standard Deviation*

3.2. Consumer Acceptability of floor wash produced from locally available materials

Table 3 shows the mean sensory scores of eco-friendly floor wash produced from locally available materials. From the table above, it was observed that the pooled mean of respondents was 5.65 which exceeded the decision rule of 5.00 indicating that the respondents liked the locally produced floor wash to a slightly low extent. The standard deviation of 2.18 which is higher than the bench mark of 1.50 showed that the disparity in agreement was wide, which simply means majority of the respondents rejected the characteristic of the floor wash such as foaming, odour and quality.

Table 3: Mean Sensory Scores for floor wash

Items	X	SD	Remark
Colour	4.55	2.48	Moderately low extent
Foaming	7.45	1.84	High extent
Odour	5.90	2.29	Slightly low extent
Quality	5.20	2.11	Slightly low extent
Acceptability	5.15	2.20	Slightly low extent
Pooled Mean	**5.65**	**2.18**	**Slightly low extent**

Keys: *X=Mean Response of respondents SD= Standard Deviation*

3.3. Consumer Acceptability of liquid soap produced from locally available materials

Table 4 shows the mean sensory scores of eco-friendly liquid soap produced from locally available materials. From the table above, it was observed that the pooled mean of respondents was 6.53 which exceeded the decision rule of 5.00 indicating that the respondents liked the locally produced liquid soap to a slightly high extent. The standard deviation of 1.76which is higher than the bench mark of 1.50 showed that the disparity in agreement was wide, which simply means majority of the respondents accepted some of the characteristic of the liquid soap such as foaming, odour and quality but do not fully accept the color of the liquid soap.

Table 4: Mean Sensory Scores for liquid soap

Items	X	SD	Remark
Colour	5.95	2.35	Slightly low extent
Foaming	7.20	1.10	High extent
Odour	6.15	2.20	Slightly high extent
Quality	6.65	1.56	Slightly high extent
Acceptability	6.70	1.62	Slightly high extent
Pooled Mean	**6.53**	**1.76**	**Slightly high extent**

Keys: *X=Mean Response of respondents SD= Standard Deviation*

3.4. Mean Rating for the Research Question

Research Question One

To what extent do you rate the locally produced household cleaners?

Table 5 shows the rating of the locally produced household cleaners. It was observed that all the items were above the cutoff point of 5.00 excluding odour which had a mean rating of 2.7. This indicates that all the respondents were in agreement that the locally produced household cleaners had good quality and good colour, and are acceptable but did not have good Odour. The calculated pooled mean for working mothers was 6.04 and housekeepers 6.05 which is above the decision rule of 5.0. This means that the respondents accepted the locally produced household cleaners based on the quality and colour alone. The standard deviation of 0.00 showed that there is no disparity in agreement. There is a harmonious agreement among the respondents on the extent to which they rated locally produced household cleaners.

Table 5: Rating of the locally produced household cleaners

Items	X_1	X_2	X_G	SD	Remark
Acceptance	6.20	7.60	6.90	0.98	Slightly high extent
Quality	8.30	7.50	7.90	0.56	High extent
Colour	6.50	6.90	6.70	0.28	Slightly high extent
Odour	3.18	2.22	2.70	0.67	Very low extent
Pooled Mean	**6.04**	**6.05**	**6.05**	**0.62**	**Slightly high extent**

Keys: X_1=Mean Response of working Mothers, X_2= Mean Response of House Keepers, X_G= Average Mean rating of Both Respondents, *SD*= Standard Deviation

Research Question Two

To what extent is locally produced toilet cleaner acceptable in terms of quality?

Table 6 shows the extent to which the locally produced toilet cleaner is acceptable in terms of quality. From table 4.9, it was observed that the rating of the quality of locally produced toilet cleaner was 8.3 for working mothers and 7.5 for housekeepers which is above the cutoff point of 5.00. This indicates that all the respondents were in agreement that the locally produced toilet cleaner had good quality and was acceptable but they did not accept the color of the locally produced toilet cleaners

The aggregate pooled mean of 5.95 exceeds the decision rule of 5.00 which means that the respondents accepted the locally produced toilet cleaner. The standard deviation of 0.68 shows that the disparity in agreement was not wide. There is a close harmonious agreement among the respondents on the extent to which locally produced toilet cleaner was acceptable in terms of quality.

Table 6: The extent to which locally produced toilet cleaner is acceptable in terms of quality

Items	X_1	X_2	X_G	SD	Remark
Acceptance	6.20	7.60	6.90	0.98	Slightly high extent
Quality	8.30	7.50	7.90	0.56	High extent
Colour	2.40	1.50	1.95	0.63	Extremely high extent
Odour	6.05	8.10	7.70	0.56	High extent
Pooled Mean	**5.73**	**6.17**	**5.95**	**0.68**	**Slightly low extent**

Keys: X_1=Mean Response of working Mothers, X_2= Mean Response of House Keepers, X_G= Average Mean rating of Both Respondents, *SD*= Standard Deviation

Research Question Three

To what extent do locally produced household cleaners differ from commercially marketed ones?

Table 7 shows the extent to which the locally produced household cleaners differ from th commercially marketed ones. It was observed that the rating of the locally produced household cleaners were very similar to the commercial ones because the calculated mean difference of odour, quality and acceptance were all below the decision rule of 5.0, which simply means there were no differences between the commercially marketed household cleaners and the locally produced ones in terms of odour, quality and acceptability but there was a difference between commercially marketed household cleaners and locally produced one mean in respect to the colour of the locally produced household cleaners since the calculated difference of 5 is higher than the bench mark of 5.00.

The rating of the colour of the locally produced household cleaners was 1.95 which is slightly below the cutoff point of 5.00. This indicates that the respondents are not in agreement and believe the color of the commercially marketed household cleaner is far much better than the color of the locally produced household cleaners. The commercially marketed household cleaners have a rating of color to be 6.95 which exceeds the decision rule of 5.00, this implies that the respondents accepts that commercially marketed household cleaners are far better than locally produced household cleaners in terms of color.

Table 7: difference between locally produced household cleaners and commercially marketed ones

Items	X_1	X_2	X_G	SD	CM_1	CM_2	CM_G	CMSD	DIFF	Remark
Acceptance	6.20	7.60	6.90	0.98	7.20	8.03	7.75	0.77	0.85	**No Diff**
Quality	8.30	7.50	7.90	0.56	8.30	8.06	8.45	0.21	0.55	**No Diff**
Colour	2.40	1.50	1.95	0.63	7.00	7.00	6.95	0.07	0.05	**Diff**
Odour	6.05	8.10	7.70	0.56	8.60	8.60	8.10	0.70	0.40	**No Diff**
Pooled Mean	**5.73**	**6.17**	**5.95**	**0.68**	**7.50**	**8.13**	**7.81**	**0.44**	**7.02**	**High extent**

Keys: ***X_1****=Mean Response of working Mothers of locally produced household cleaners,* ***X_2****= Mean Response of House Keepers of locally produced household cleaners,* ***X_G****= Average Mean rating of Both Respondents on locally produced household cleaners,* ***SD****= Standard Deviation of locally produced household cleaners,* ***X_{agg}****= Average mean rating for locally produced household cleaners.* ***CM_1****=Mean Response of working Mothers of commercially marketed household cleaners,* ***CM_2****= Mean Response of House Keepers of commercially marketed household cleaners,* ***CM_G****= Average Mean rating of Both Respondents on commercially marketed household cleaners,* ***CMSD****= Standard Deviation of commercially marketed household cleaners,* ***DIF****= difference of locally produced household cleaners from commercially marketed ones ($CM_G - X_G$)*

Research Question Four

To what extent are locally produced floor wash acceptable in terms of colour

Table 8 shows the extent to which the locally produced floor wash cleaner is acceptable in terms of colour. It was observed that the rating of the colour of locally produced floor wash was 6.05 for working mothers and 8.1 for housekeepers which is above the cutoff point of 5.00. This indicates that the respondents agreed that the colour of the locally produced floor wash was good**.** The Average mean of both respondents mean was 7.07 which is above the decision rule of 5.00 implied that the respondents accepted the colour of the locally produced floor wash. The standard deviation of 0.56 showed that the disparity in agreement was not wide. There was a close harmonious agreement among the respondents on the extent to which locally produced floor wash was acceptable in terms of colour.

Table 8: The extent to which locally produced floor wash are acceptable in terms of colour

Items	X_1	X_2	X_G	SD	Remark
Acceptance	6.20	7.60	6.90	0.98	Slightly high extent
Quality	8.30	7.50	7.90	0.56	High extent
Pooled Mean	**6.05**	**8.10**	**7.07**	**0.56**	**High extent**

Keys: X_1=Mean Response of working Mothers, X_2= Mean Response of House Keepers, X_G= Average Mean rating of Both Respondents, *SD*= Standard Deviation

Research Question Five

To what extent are locally produced liquid soap are acceptable in terms of odour?

Table 9 shows the extent to which the locally produced liquid soap is acceptable in terms of odour. It was observed that the rating of the odour of the locally produced liquid soap was 3.18 for working mothers and 2.22 for housekeepers which was below the cutoff point of 5.00. This indicates that the respondents did not like the odour of the locally produced liquid soap. The average mean rating of both was 2.7 which is below the decision rule of 5.00 implied that the respondents did not like the odour of the locally produced liquid soap. The standard deviation of 0.76 showed the disparity in agreement was not wide. That there is a harmonious agreement among the respondents on the extent to which locally produced liquid soap was acceptable in terms of odour.

Table 9: The extent to which locally produced liquid soap is acceptable in terms of odour

Items	X_1	X_2	X_G	SD	Remark
Acceptance	6.20	7.60	6.90	0.98	Slightly high extent
Quality	8.30	7.50	7.90	0.56	High extent
Pooled Mean	**3.18**	**2.22**	**2.70**	**0.67**	**Very low extent**

Keys: X_1=Mean Response of working Mothers, X_2= Mean Response of House Keepers, X_G= Average Mean rating of Both Respondents, *SD*= Standard Deviation

3.5. Research Hypotheses

H_{01}: There is no significant difference between the mean ratings of respondents on how locally produced toilet cleaner is acceptable in terms of quality

Table 10 shows the result of analysis of z-test of the stated hypothesis. The table showed that the calculated Z-value of 1.123 was lesser than the critical r-value of 1.68 at 141degrees of freedom and 0.05 alpha level of significance. Hence, the null hypothesis was accepted and the alternate hypothesis was rejected which simply means there was no significant difference between the mean ratings of respondents on how locally produced toilet cleaner is acceptable in terms of quality. The results in the table revealed that the z-values of the research questions which were administered to the respondents were lower than the adopted critical value (0.05). Based on the stated decision rule above, the null hypothesis was accepted. The inference is that the mean ratings of housekeepers and working mothers on how locally produced toilet cleaner was acceptable in terms of quality was significant to one another. The researcher can conclude that because the calculated significant value of 1.123 was lower than the critical r-value of 1.68 at 0.05 level of significance that the mean rating of working mothers and housekeepers are not likely to change.

Table 10: Result of analysis of Z-Test of the stated hypothesis

Respondents	Mean rating	S.D	Diff	Cal z-value	Result
Working mothers	8.30				

		0.56	141	1.123	Not significant
House keepers	7.50				

H_{02}: there is no significant difference between the mean ratings of respondents on how locally produced household cleaners differ from commercially marketed ones

Table 11 shows the result of analysis of z-test of the stated hypothesis that there is no significant difference between the mean ratings of respondents on how locally produced household cleaners differ from commercially marketed ones. The table showed that the calculated Z-value of -1.412 was lower than the critical r-value of 1.68 at 141degrees of freedom and 0.05 alpha level of significance. Hence, the null hypothesis was accepted and the alternate hypothesis was rejected which simply means there was no significant difference between the mean ratings of respondents on how locally produced household cleaners differed from commercially marketed ones.

The results in the table also revealed that the z-values of the research questions which were administered to the respondents were lower than the adopted critical value (0.05). Based on the stated decision rule above, the null hypothesis was accepted. Therefore, rejecting the alternative hypothesis which implied that there was a significant difference between the mean ratings of respondents on how locally produced household cleaner differed from commercially marketed ones. The inference is that the mean ratings of housekeepers and working mothers on how locally produced household cleaner differ from commercially marketed ones is significant to one another. The researcher can conclude that because the calculated significant value of -1.1412 was lower than the critical r-value of 1.68 at 0.05 level of significance that the mean rating of working mothers and housekeepers are not likely to change.

Table 11: Result of analysis of Z-Test of the stated hypothesis

Respondents	Mean rating	S.D	Diff	Cal z-value	Result
Working mothers	6.11				
		0.169	141	-1.412	Not significant
House keepers	7.81				

H_{03}: There is no significant difference between the mean ratings of respondents on how locally produced floor wash is acceptable in terms of colour

Table 12 shows the result of analysis of z-test of the stated hypothesis that there is no significant difference between the mean ratings of respondents on how locally produced floor wash is acceptable in terms of colour. Result showed that the calculated Z-value of -2.511 was higher than the critical r-value of 1.68 at 141degrees of freedom and 0.05 alpha level of significance. Hence, the null hypothesis was rejected and the alternate hypothesis was accepted which simply means there was a significant difference between the mean ratings of respondents on how locally produced floor wash is acceptable in terms of colour.

The results also revealed that the z-values of the research questions which were administered to the respondents were higher than the adopted critical value (0.05). Based on the stated decision rule above, the null hypothesis was rejected. Therefore, accepting the alternative hypothesis

which implied that there was a significant difference between the mean ratings of respondents on how locally produced floor wash was acceptable in terms of colour. The inference is that the mean ratings of housekeepers and working mothers on how locally produced floor wash are acceptable in terms of colour is not significant to one another. The researcher can conclude that because the calculated significant value of -2.511 was higher than the critical r-value of 1.68 at 0.05 level of significance that the mean rating of working mothers and housekeepers are not likely to change.

Table 12: Result of analysis of Z-Test of the stated hypothesis

Respondents	Mean rating	S.D	Diff	Cal z-value	Result
Working mothers	6.05				
		0.560	141	-2.511	Significant
House keepers	8.10				

H_{05}: There is no significant difference between the mean ratings of respondents on how locally produced liquid soap is acceptable in terms of odour

Table 13 shows the result of analysis of z-test of the stated hypothesis that there is no significant difference between the mean ratings of respondents on how locally produced liquid soap is acceptable in terms of odour. The result showed that the calculated Z-value of .861 was lesser than the critical r-value of 1.68 at 141degrees of freedom and 0.05 alpha level of significance. Hence, the null hypothesis was accepted and the alternate hypothesis was rejected which simply means there was no significant difference between the mean ratings of respondents on how locally produced liquid soap is acceptable in terms of odour.

The results in the table revealed that the z-values of the research questions which were administered to the respondents were lower than the adopted critical value (0.05). Based on the stated decision rule above, the null hypothesis was accepted. Therefore, rejecting the alternative hypothesis which implied that there was a significant difference between the mean ratings of respondents on how locally produced liquid soap is acceptable in terms of odour. The inference is that the mean ratings of housekeepers and working mothers on how locally produced liquid soap are acceptable in terms of odour is significant to one another. The researcher can conclude that because the calculated significant value of .861 was lower than the critical r-value of 1.68 at 0.05 level of significance that the mean rating of working mothers and housekeepers are not likely to change.

Table 13: Result of analysis of Z-Test of the stated hypothesis

Respondents	Mean rating	S.D	Diff	Cal z-value	Result
Working mothers	3.18				
		0.523	141	0.861	Not significant

House keepers	2.22

Summary of Findings

1. The response of respondents to the locally produced household cleaners was slightly high in terms of acceptability
2. The response on the acceptability of locally produced toilet cleaner in terms of quality was positive
3. There was a difference between the mean response on how locally produced household cleaners and commercially marketed ones differ in terms of colour. The commercially marketed ones were brighter in colour because of addition of chemicals.
4. The response on the acceptability of locally produced floor wash in terms of colour was positive
5. The response on the acceptability of locally produced liquid soap in terms of odour was negative because the locally produced liquid soap was without fragrance.
6. There was no significant difference between respondents on the extent to which locally produced toilet cleaner were acceptable in terms of quality
7. There was no significant difference between respondents on the extent to which locally produced household cleaners differ from commercially marketed ones
8. There was a significant difference between respondents on the extent to which locally produced floor wash were acceptable in terms of colour. The commercially marketed ones used as control had red passion fruit extract added to it which gave it a red colour.
9. There was no significant difference between respondents on the extent to which locally produced liquid soap were acceptable in terms of odour

4. DISCUSSION

The result of the study revealed that the locally household cleaners such as floor wash, liquid soaps and toilet cleaner were acceptable in terms of quality. The result of the study further showed that respondents' response differed with respect to the colour and the odour of locally made household cleaners especially the locally produced liquid soap. The correspondent hypotheses affirmed that there was no significant difference between the respondents on how locally produced toilet cleaner is acceptable in terms of quality. It implies that there was no significant relationship between the respondents on the acceptability and quality of the locally produced toilet cleaner. The finding is in agreement with the finding of Lackney and Picus [9] who argued that toilet cleaner should have good quality odour and colour so as to be acceptable by the general public. The finding is also in line with the finding of Asiabaka [10] who noted that there is a direct relationship between quality of a product and the product itself. He further opined that the quality of a product will increase customer retention, so instead of focusing on quantity, the focus should be on quality as quality is a key to customer satisfaction and retention

Furthermore, the study revealed that the locally produced household cleaners differed from commercial ones only in terms of colour. The correspondent hypothesis revealed that there was no significant relationship between respondents on how locally produced household cleaners differs from commercial ones. The finding is in agreement with the views of Amanchukwu and Nwachukwu [11] who explained that locally produced household cleaners differed from

commercial one in terms of colour, odour and quality. He further opined that most locally produced household cleaners are not acceptable in the market because they have bad odour, poor mixtures of colour and cheap materials which leads to poor quality of the product. The finding is also in line with the Asaiabka [10] who noted that commercially marketed household cleaners have good fragrance, colour and of better than quality than locally produced households cleaners.

The finding of the study revealed that there was a significant difference between respondents on how the locally produced floor wash is acceptable in terms of colour. This implied that the locally produced floor wash was acceptable in terms of colour. The finding is in contrast with the views of Amanchukwu and Nwachukwu [11] who explained that locally produced household cleaners differed from commercial one in terms of colour, odour and quality. He further opined that most locally produced household cleaners were not acceptable in the market because they had bad odour and colour.

The finding of the study revealed that there was no significant difference between respondents on how locally produced liquid soap is acceptable in terms of odour. This indicates that the locally produced liquid soap is not acceptable in terms of odour. The correspondent hypotheses affirmed that there was no significant difference between the respondents on how locally produced liquid soap was acceptable in terms of odour. It implies that there was no significant relationship between the respondents on how locally produced liquid soap is acceptable in terms of odour. The finding is in agreement with the finding of Lackney and Picus [9] who argued liquid soap should have good quality odour and colour so as to be acceptable by the general public. The finding is also in line with the finding of Asiabaka [10] who noted that there is direct relationship between quality of a product and the product itself. He further opined that the quality of a product will increase customer retention, so instead of focusing on quantity, focus on quality is a key to customer satisfaction and retention.

5. CONCLUSION

Based on the findings of the study, the researcher concluded that the acceptability of the locally produced household cleaning products relied on the quality, colour and odour of the product. The result also showed that it is possible to produce eco-friendly household cleaning products such as liquid soap, floor wash, toilet cleaner using locally available materials. This study therefore contributes to knowledge by developing new recipes for the production of eco-friendly household cleaning products using local available materials.

6. RECOMMENDATIONS

1. It is recommended that fragrance be added to the cleaning products in order to give good odour.
2. The production of locally made household cleaning products could be taught across Nigerian schools as to increase the productivity of locally made cleaners in other to meet customers demand.
3. Government should provide the enabling environment for small and medium enterprises to thrive and enable them access loan for procurement of appropriate equipment used in the production of household cleaning products.
4. Studies should be carried out to ascertain the efficacy of the household cleaning products against microbes.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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