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Application of Detergent as Enhancer in Cassava Flour Processing: A Threat to Life

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Abstract

Introduction: Cassava flour is a processed product from Cassava tuber *(Manihot esculenta Crantz)* as a staple food, it is a major source of carbohydrate. Due to effects of climate related variables (dry and rain season) on the production and processing of cassava, rural dwellers have adopted the practice of using detergent (linear alkyl benzene sulfonate, LABS) to enhance the process of fermentation of cassava. **Purpose of the Study:** The study on the application of detergent as enhancer in cassava flour processing: A threat to life was purposely designed to substantiate the assertion that, detergent are used to aid fermentation of cassava. **Materials and Methods:** Samples of cassava tubers were randomly collected from three (3) farms, they were peeled, washed and soaked in detergents of concentrations; 0.05g/L, 0.1g/L and 0.5g/L and their rates of fermentation and pH were monitored, a control (sample without detergent) was also set up for comparison. A total of three (3) cassava flour were obtained from Wukari market, North Eastern Nigeria and were subjected to the same analysis with other samples in the laboratory. All samples were characterized with Fourier Transform Infra-Red (FTIR), titrimetric method for residual detergent (LABS) and Flame photometer for Na concentrations.

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Results: The results obtained showed that the sample with least concentration of detergent (0.05 g/L) fermented within 48 hrs without objectionable odour, followed by 0.1 g/L at 54 hrs and 0.5 g/L at 68 hrs, the control sample fermented after 72 hrs with undesirable odour. The results of FTIR and Flame Photometer indicate the presence of Silicate, Azide and Na in both samples. **Conclusion:** The findings have proved that some of the Cassava Flour sold within Wukari Metropolis contained high concentration of residual LABS and sodium which have adverse effect on humans.

Keywords: Cassava, Detergent, Enhancer, Fermentation, Flour

INTRODUCTION

Recently interest has been focused on foliage from cassava (*Manihot Esculenta'Crantz')* as supplemental feed for ruminant animals. Cassava is known as highly tropical crop that is traditionally cultivated to produce roots tubers for human consumption or for starch production. Nigeria is the world's largest producer of Cassava, with other world's producers like Indonesia, Thailand, the democratic Republic of Congo, Ghana and Angola. It has been estimated in 2010 Nigeria's production of Cassava reaches 37.5 million tonnes and increased to about 54 metric tonnes in 2012 (FAOSTAT, 2012). Cassava is a versatile crop and can be processed into a wide range of products such as Starch, Flour, Tapioca, beverages and Cassava chips for animal feed, Cassava is also gaining prominence as an important for the emerging bio fuel industry and, as corroborated by Olukanni and Tope (2018). Fermentation was traditionally a process which enables to preserve food and as such has been used for centuries until present. However nowadays, the main purpose of food fermentation is not to preserve, since other preservation techniques are used, but to produce a wide variety of fermentation products with specific taste, flavour, aroma and texture. Using various microbial strain, fermentation condition, (microorganisms' substrate, temperature, time of fermentation etc. Cassava processing method involve different combination of drying, grating, soaking, boiling and fermentation of whole or fragmented roots reduce the total cyanide content of Cassava products (Huan *et al.,* 2019).

The need to accelerate the fermentation process of Cassava has arisen because of a rapidly increasing population and climate change, during fermentation cassava roots are softened by the application of detergent ($[C_{12}H_{25}SO_3]^+Na^+$; linear alkyl benzene sulfonate (LABS) on the activity of Cassava cell wall degrading enzyme (α-amylase, phosphorylase and pectin methyl esterase)

MATERIALS AND METHODS

Description of the Study Area

The study was carried out in Wukari is a Local Government Area in Taraba State, Nigeria with its headquarters in Wukari town on the A4 high way. The Local Government has an area of 4,308 Km^2 of and a Population of 241,546 as of 2006 census, it is located on latitude: 7°52'17.0"N and longitude: 9°46'40.30"E. The River Donga and Benue flows through the area in the North and South respectively. It has boundary with Benue and Nassarawa state to the Southwest (Hikon *et al.,* 2018).

Collection and Preparation of Samples

Samples of cassava tubers were randomly collected from three (3) farms, they were peeled, washed with distilled water. A 1.0 kg of the washed tubers were soaked in detergents of three different concentrations; 0.05 g/L, 0.1 g/L and 0.5 g/L and their rates of fermentation and pH were monitored, a control (cassava tubers sample without detergent solution) was also set up for comparison. The fermentation process was monitored and their pH was recorded at the end of the fermentation process, after fermentation; the softened cassava tubers were washed to remove the fermented water. The residues were mulched with hand for about 30 minutes; the same temperature was maintained throughout the analysis, the softened cassava tubers were processed into paste by washing off the fiber from the pulp. The pastes were dried in the sun, pounded using an iron mortar and pestle and were later sieved to obtain a representative sample. About three cassava flour selling points were mapped out in the Wukari new market. A 100 g of the samples were purchased and taken to laboratory for further analysis.

Determination of Na Concentrations

1 g of each sample were weighed into a Pyrex beaker and 5ml of concentrated HNO_3 was added, followed by 3 ml of H_2O_2. The mixture was heated for 1 hour at 160 ℃ on hot plate, then the mixture was allowed to cool to room temperature. The mixture was filtered into a 50 ml sample bottle and made up to the mark. The filtrate was analyzed using a simple flame photometer (Model 410, Corning and Halstead, UK) with filters for lithium, sodium, and potassium (Min-Jane *et al.,* 2004)

Determination of % Linear Alkyl Benzene Sulfonate (LABS)

A 1 g (sample A, B, C X, Y, and Z) of Cassava flour were dissolved in small quantity of warm water, 2-3 drops of phenolphthalein indicator was added into each of the solution. The solutions were transferred quantitatively into a 500ml volumetric flask, which was swirled properly to obtain a uniform coloration. 5ml of the solution was pipette into a Stoppered measuring cylinder containing 15 ml of chloroform and 25 ml of methylene blue indicator and was titrated against Cetyl Ammonium Bromide (CAB) until two layered uniform blue colour separated by a ring were observed (NASCO, 2021).

$$\%ABS = \frac{\text{Titre value of } CAB \times CAB \text{ factor} \times 0.9353}{\text{Sample weight taken}}$$

RESULTS AND DISCUSSION

pH

The result of pH presented in Table 1 below showed the pH values of fermented cassava water and the rate of fermentation. The results indicates that the pH decreases as fermentation rate increases, tending towards acidity. Sample C had the highest pH value (9.2.00±0.90), followed by sample B (5.90±0.32) and A (5.10±0.43) while pH of samples purchased increases in the order; X > Y > Z. The results obtained showed that sample (A) with least concentration of detergent (0.05 g/L) fermented within 48 hrs without objectionable odor, followed by sample B (0.1 g/L) at 54 hrs and sample C (0.5 g/L) at 68 hrs, with undesirable odor while the control sample (Cl) fermented at 72 hrs without offensive odor. The pH values of the control sample (Cl), sample A and B were within the recommended values of 5 – 7 as reported by Sanni *et al.,* (2019).

Table 1. Mean Values of pH of Cassava Samples

samples	pH of Sample Solution	Time (Hours)
Control	7.20±0.89	72
A	5.10±0.43	48
B	5.90±0.32	54
C	9.2.00±0.90	68
X	6.17±0.55	NA
Y	6.00±0.43	NA
Z	7.00±0.32	NA
Recommended IITA, Ibadan (2005)	5 - 7	

NA: Not Available

The results obtained in this findings is similar to those reported by Umeh and Odido (2014) and Salami *et al*., (2011) where the use of additives affected pH rate, with different additives having its specific rate decrease. Therefore, diminishing pH indicates microbial growth which affects cassava tuber hydrolysis and indicates that fermentation occurred. The acidity was increasing while pH was decreasing, as reported by Salami *et al*., (2011) and Umeh and Odido (2014). So decrease in pH is followed by a corresponding increase in the acidity meaning fermentation is faster. According to Oyewole (2010), the use of nail showed the pH decrease from 7.24 to 4.99, the use of scent leaf decreased from 7.16 to 5.75 and the control from 7.26 to 5.77.

Linear Alkyl Benzene Sulfonate and Sodium

The results of LABS are presented in Table 2. The findings showed that the control sample had no traces of LABS, indicating that detergent was not used during fermentation. The concentration of LABS in sample C was found to be 14.0±0.90 %, sample B had 12.0±0.80 % and sample A recorded 9.90±0.50 % LABS, it's evident that the residual LABS is as a result of the application of detergent used to aid the fermentation process.

The results of samples obtained from different points in Wukari market indicates the amount of residual LABS as follows; sample X had 9.30±1.20 %, sample Y recorded 8.60±4.10% and Z had 0.8±2.00 % indicating that detergent were used by the locals during fermentation in winter period.

The dissolution of detergent in water is an exothermic process, which means heat is released when the detergent dissolves in water and the property is called heat of solution. This is why you feel warm to the touch when dissolves in water, this lowered the amount of oxygen present in the water, hence enhances fermentation process of the cassava tubers. Fitrihidajati *et al.,* (2020) reported that, detergent in water can causes a reduction in oxygen levels of water and a concentration of 0.5 mg/l of detergent has been able to form a foam that inhibits the diffusion of oxygen from the air to the surface of the water body.

Table 2. Concentration of Linear Alkyl Benzene Sulphonate and Sodium

Sample	Concentration of Na (mg/kg)	Concentration of LABS (%)
Cl	20.6±1.90	ND
A	80.0±2.40	9.9±0.50
B	88.0±1.40	12.0±0.80
C	95.1±2.90	14.0±0.90
X	76.5±1.20	9.30±1.00
Y	75.0±4.10	8.60±2.50
Z	26.0±2.00	0.80±0.05

ND: Not Detected

The results of mean concentrations of sodium were reported in Table 2 above. The concentration of Na in sample A was found to be 80.0±2.40 mg/kg, indicating that detergent was used during fermentation followed by sample B with 88.0±1.40 mg/kg while sample C had 95.1±2.90 mg/kg while the control sample Cl recorded 20.6±1.90 mg/kg of Na. Furthermore, it was found that concentration of Na increased with increase in the concentration or quantity of detergent used during fermentation.

The samples obtained from Wukari markets showed that sample X gave mean concentration of 76.5±1.20 mg/kg, sample Y had 75.0±4.10 mg/kg of Na whereas 26.0±2.00 mg/kg was observed in sample Z. The values obtained for sodium concentration in the control sample (Cl) and sample Z obtained from Wukari market were within the allowable limit. However, sample A, B, C prepared in the laboratory and sample X and Y obtained from cassava flour sellers in Wukari market had values above the permissible limit of 74 mg/kg for sodium in cassava as reported by Sanni et al, (2005). Faquhar *et al.,* (2015) reported that Sodium is essential for cellular homeostasis and physiological function. Excess dietary sodium has been linked to elevations in blood pressure and excess dietary sodium can adversely affect target organs, including the blood vessels, heart, kidneys, and brain

Characterization of Sample

The result of FTIR spectra of the control sample (Cl) displayed in Figure 1 revealed the following functional groups that are present in the sample; alcohols: O-H stretch (3272.6 cm^{-1}), alkanes: C-H stretch (2929.7 cm^{-1}), Starch: CH_2 – OH (1200 – 1020 cm^{-1}), water: H_2O (1640.0 cm^{-1}) etc indicating that the sample is characterized by Starch (Carbohydrate)

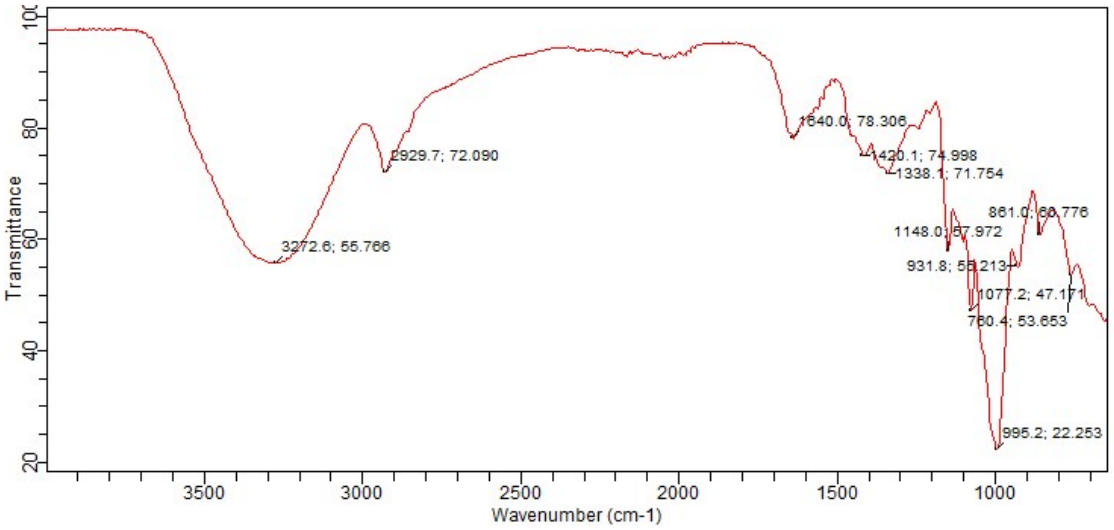


Figure 1. FTIR Spectrum of the Control Sample (Cl).

The result of sample A and B which was fermented with 0.05 and 0.10 g/L detergent solution showed the various functional groups associated with the samples; alcohols: O-H stretch (3272.6, 3265.1 cm^{-1}), alkanes: C-H stretch (2829.7, 2840.2 cm^{-1}), water: H_2O (1636.3 cm^{-1}), silicon compound Si-O-Si (2050.0, 1982.9 cm^{-1}), Ester: C-O Stretch (1077.2 cm^{-1}), Sulfonate: S=O stretch (1372 – 1335 cm^{-1}) while sample C which was fermented with 0.5 g/L detergent solution had similar functional groups as sample A and B. In addition it has some functional groups which are carboxylic acid: C=O (3324.8, 1736.9 cm^{-1}), aromatic compound: C-H bend (1938.2 cm^{-1}). The presence of azide (N=N=N) and ester could be as a result of the addition of color and fragrance in the detergent, the sulfonate and benzene compound could be attributed to the reaction of sulfonic acid with alkaline that formed linear alkyl benzene sulfonate (LABS). The results obtained for sample A, B and C showed a significant difference in their functional groups with respect to the control sample (Cl) which do not contained detergent. It is obvious from the spectrum as some ingredients used in detergent production were detected

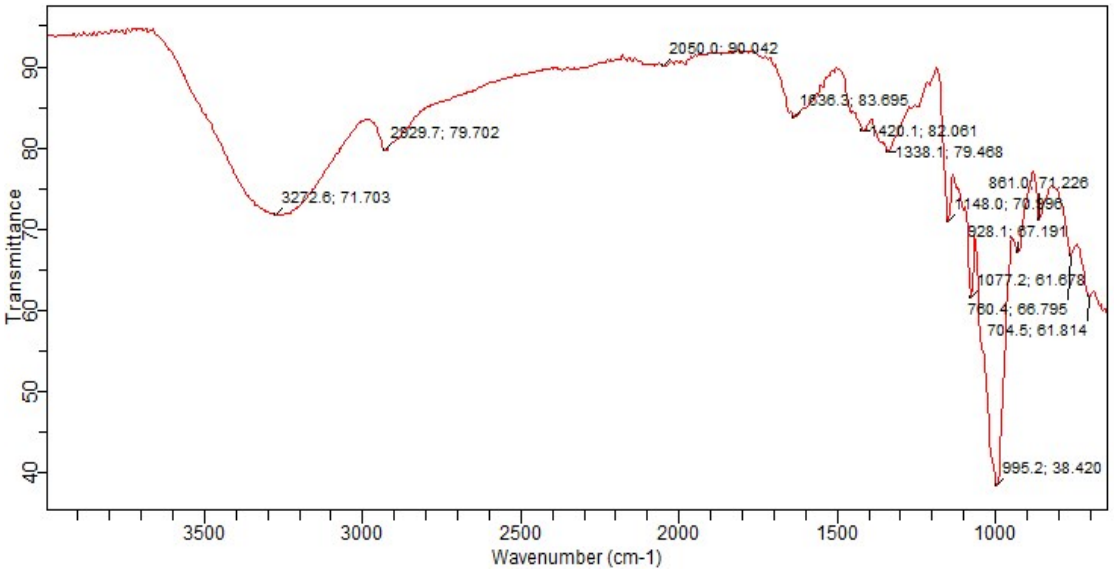


Figure 2. FTIR Spectrum of Sample A

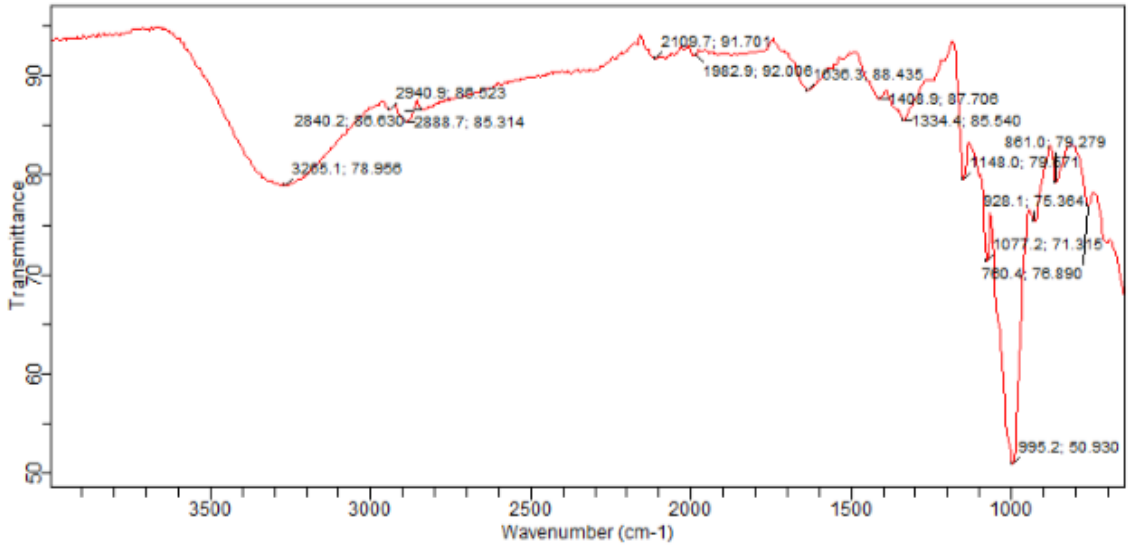


Figure 2. FTIR Spectrum of Sample B

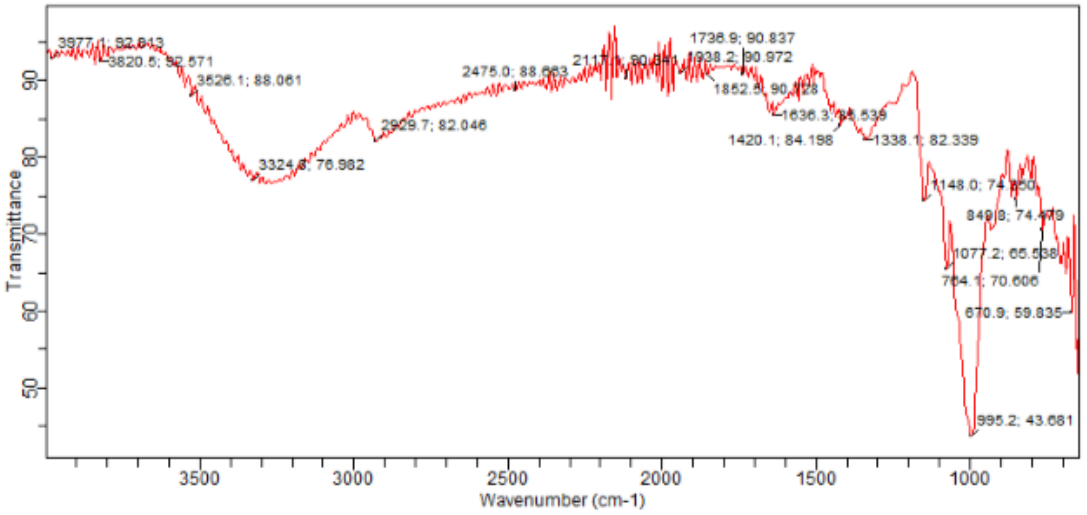


Figure 3. FTIR Spectrum of Sample C

The FTIR results of sample X, Y and Z which were purchased from market when compare with those of sample A, B, C and Cl prepared in the laboratory, it is noticeable that samples X contained a silicon compound: Si-O-Si (2076.1 cm^{-1}) and Ester: C-O Stretch (1148.0 cm^{-1}) which are ingredient in detergent production.

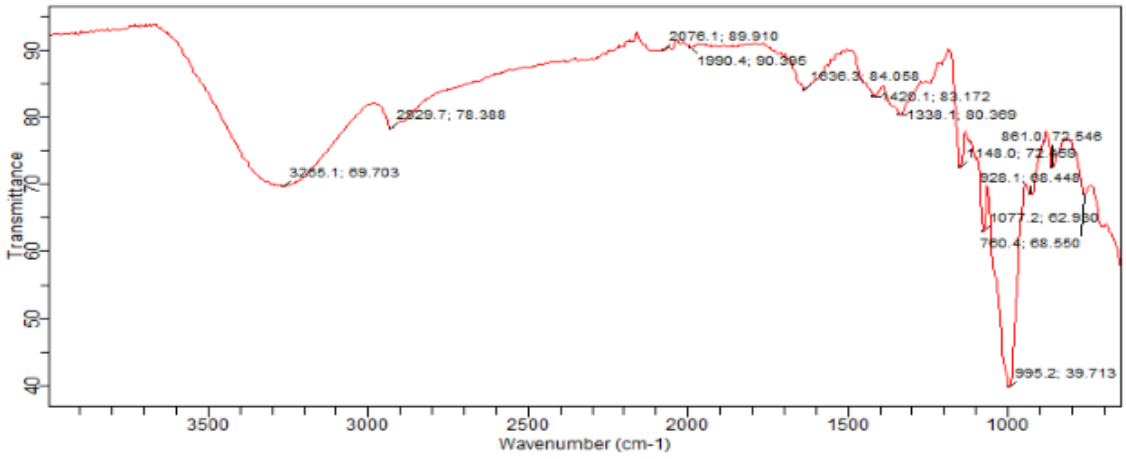


Figure 4. FTIR Spectrum of Sample X

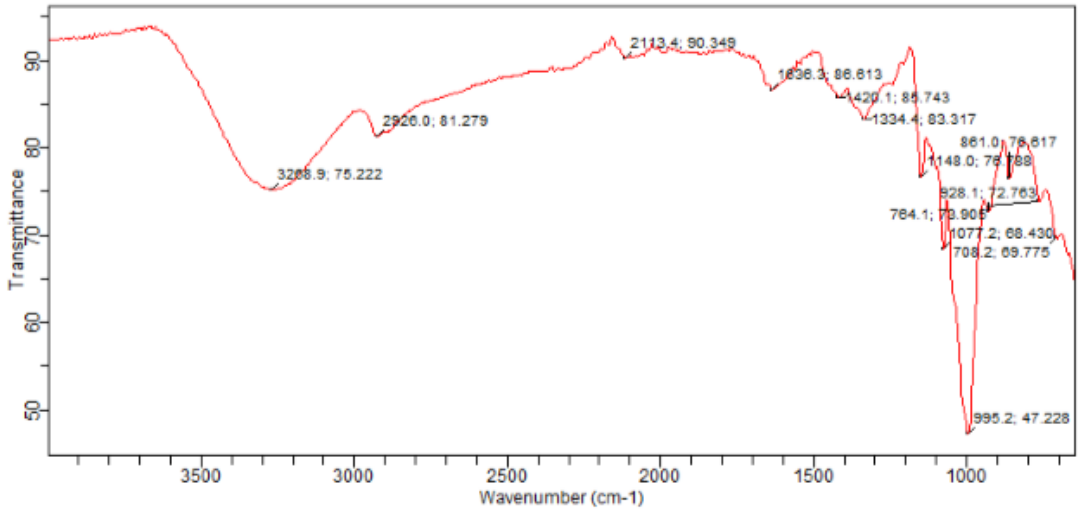


Figure 5. FTIR Spectrum of Sample Y

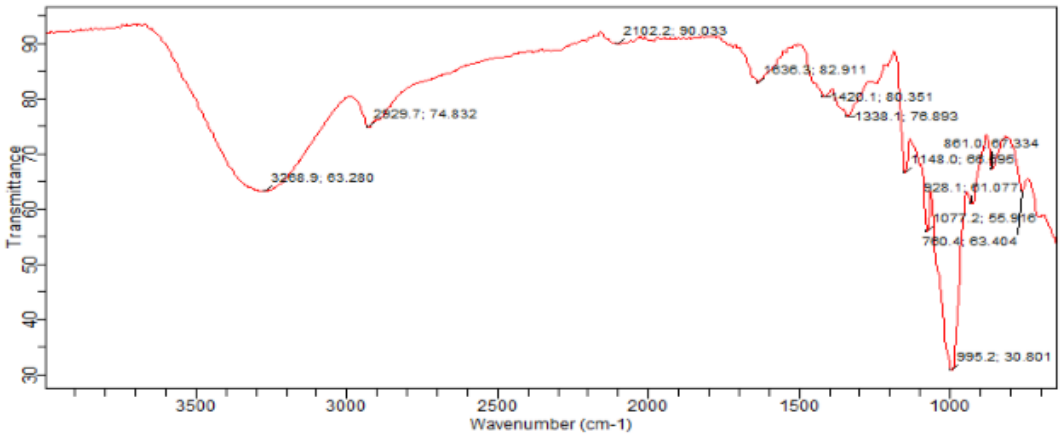


Figure 6. FTIR Spectrum of Sample Z

Similarly, sample Y and Z indicated the presence of azide: N=N=N (2113.4, 2102.2 cm^{-1}) and Sulfonate: S=O stretch (1334.4 – 1338.1 cm^{-1}), this implied that some cassava flour sold in Wukari market were processed with detergent so as to aid fermentation in winter period. Similar findings was reported by Salami *et al.,* (2011) in which they concluded that the used of nail and trona increases rate of fermentation than LABS.

CONCLUSION

The rate of fermentation depend on pH, temperature, surface tension and microbial activities. The results revealed that decrease in pH increases the rate of microbial activities, hence reducing fermentation time. The research achieved a better result since the rate of fermentation aided by LABS was faster than the control sample (without detergent). However, minimal concentration of LABS yield better result than at high concentration.

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