Antibacterial Activity Of Corn [Zea Mays Var Rugosa] And Brominated Corn Seed Oil

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Abstract:** Corn [zea mays var rugosa] seed oil was soxhlet extracted with n-hexane and then brominated. The oil quality parameter of both the corn (CO) and the Brominated Corn oil (BCO) were determined. IR spectroscopy was used in confirming the bromination. The oil and moisture content of corn oil (CO) were 8.90% and 10.5% respectively. The saponification value (SV), Peroxide value (PV), Iodine Value (IV) and Acid value (AV) were found to be; (136.1± 0.265 mgKOH/g), (12.23 ± 0.586meq/kg), (102.04± 0.990 gl_2/100g) and (5.26± 0.006meq/kg) and that of brominated corn oil (BCO) as (120.1± 0.002mgkoH/g), 11.27± 0.551meq/kg), (39.1± 0.242gI_2/100g) and (5.00± 0.105meg/kg respectively. The following peaks of absorptions were observed for CO:C-H stretch at 3050cm^{-1} for alkene, C-H stretch at 2950-2850 cm^{-1} for alkane, C=O stretch at 1800 cm^{-1} for carbonyl, C=C stretch at 1680 cm^{-1} for alkene and C-O stretch at 1400 cm^{-1} for ester while that of BCO include C-Br at 600 cm^{-1}, C-H stretch, (2900 to 2850 cm^{-1} for alkane), 1750cm^{-1} for carbonyl stretch, 1400 cm^{-1} for ester, 1680 cm^{-1} for alkene. A disc diffusion method was used for the antibacterial activity in which BCO showed more activity than CO. The BCO showed a broad spectrum activity against Escherichia coli, salmonella sp, staphylococcus aureus and streptococcus epidermidis microorganism which gave the inhibitions zones of 17.00mm, 16.50mm, 15.00mm,16.00mm while CO gave the zone of inhibition of 10.00 mm, 11.00 mm, 1050 mm and 11.50 mm respectively. DMSO was used as the negative control while streptomycin as the positive control at 400 mg/ml concentration. With this remarkable difference between CO and BCO, a suggestion of its use as an antimicrobial agent can be explored and exploited for its application as sanitary product such as hand sanitizers or disinfecting oil.

***Keywords:** Brominated Corn Oil, Infrared spectroscopy, microorganism and inhibition zone.*

I. INTRODUCTION

Brominated Vegetable Oils (BVO) are complex mixtures of plant-derived triglycerides that have been formed from reaction of bromine and the double bond in triglycerides (Zheng, 2014). Brominated vegetable oil has extensively been used as a food additive in soft drink production, where it serves as an emulsifying agent. However in other applications, it has been utilized for its fire retardant properties, a practice that have brought to question its continued use as a food additive (Vetter *et al*, 2010). This is arising from reported cases of Bromism (Horowitz, 1997) and the observed increase in the level of brominated fatty acids that have been observed to be stored away in the body's lipid layers (Vetter *et al*, 2010 and Yuen, 2014). To support this assertion is the reported effect of BVO on yeast population and thus its possible effect on human body cells, a fact that have been pointed out in studies with experimental animals (Patel, 2012).

Corn oil is a pale yellow liquid with a pleasant taste which has been used as a cooking oil for its low cholesterol content (Corn Refiners Association, 2006). It is obtained from the kernel of the plant *Zea mays*, commonly referred to as Corn or maize. The maize plant is grown in almost all vegetative regions of the world and constitutes a staple in the local dishes where it is found. But not until recently, the extraction and use of its oil has mainly been confined to localities in Europe and the Americas. The corn grain is reported to have 15% oil yield; with its triglyceride mostly constituting of linoleic acid and oleic acid a fact that points to its being classified as polyunsaturated oil. Corn oil is a rich source of essential fatty acids (EFA) such as Omega-6 fatty acid, Phytosterols and Tocopherols (Rajendran *et al*, 2012 and Corn Refiners Association, 2006).

The present trend is the use of natural products in fighting diseases due to their biodegradability and lack of resistance. This study therefore aims to investigate the effect of brominated corn oil as an antibacterial agent against some common disease causing bacteria.

II. MATERIALS AND METHODS

The kernel of plant *Zea mays var rugosa* hybrid (yellow corn variety) was obtained from Dass local government area (LGA), Bauchi, Nigeria. The sample was authenticated at the Biological Science Department, Abubakar Tafawa Balewa University [A.T.B.U], Bauchi.

The corn oil was soxhlet extracted using n-hexane and the oil quality parameters of the corn oil (CO) were determined using a standard methods (Abayeh, 2010). Infrared spectroscopy was used to confirm the bromination process.

BROMINATION PROCESS

This corn oil was subjected to direct bromination by adding bromine solution dropwise into the stirring oil sample in an erlenmeyer flask connected to a condenser at a maintained temperature of between 30 to 40^{0}C. The reaction was allowed to proceed for 8 hours under vigorous stirring with a magnetic. The oil quality parameters of the BCO was also determined and an Infrared (IR) spectrum was used to confirm the bromination process.

ANTIBACTERIAL EVALUATION OF CORN OIL AND BROMINATED CORN OIL

The Disc Diffusion Method for antimicrobial susceptibility testing was adopted (Urgras et al., 2006; Ladjel et al., 2010) to access the presence of the anti bacterial activity of CO and BCO. Bacteria culture of *Escherichia Coli*, *Salmonella* species, *Staphylococcus aureus* and *Streptococcus epidermidis* were used. In this method discs which have been impregnated with CO and BCO were placed on the Muller-Hinton Agar (MHA) plate surface, with each test plate comprising of 6 discs. The plates were incubated at 37^{0}C for 18 to 24 hours, after which the plates were examined for inhibition zones; diameter was measured using calipers and recorded. Controls were conducted in line with the above procedure, using streptomycin antibiotic for positive control while dimethylsulphoxide (DMSO) was used for negative control.

III. RESULTS AND DISCUSSION

The moisture content of the corn oil (10.5%) was high which might have been responsible for the hydrolysis of triglycerides to yield high level of free fatty acids leading to high refining losses and low oil yield (8.90 %). The oil quality parameters of both CO and BCO all shown in Table 1. The results of CO and BCO were close but differs widely in their IV which was due to the addition of bromine across the double bond positions in the fatty acids triglyceride (CO ;102.04 gI_2/100g and BCO;39.1 gI_2/100g) (Table 1) Iodine value (IV) is the measure of the overall unsaturation in the structural matrix of the oil and it is usually used to characterize oils and fats as non drying, semi drying and drying. However, the IV of CO and BCO falls within the non drying class. The reduction of IV in BCO (39.1 gI_2/100g) from (92.04 gI_2/100g) for CO (Table 1.) indicates that bromination has occurred but may not be to 100% completion.

S/N	Oil Quality Parameters	CO	BCO
1	FFA(% as oleic)	2.58±0.003	2.53±0.080
2	AV(meq/kg)	5.26±0.006	5.00±0.105
3	PV(meq/kg)	12.23±0.586	11.27±0.551
4	IV(gI_2/100g)	92.04±0.990	39.1±0.242
5	SV(mgKOH/g)	136.1±0.265	120.1±0.002
6	Moisture content(%)	10.50±0.002	
7	Oil Content(%)	8.90±0.00	

Table 1: Oil quality parameters of Corn Oil and Brominated Corn Oil

The infrared spectra obtained for the Corn Oil as presented in Table 2 the absorption band around the 1680 cm^{-1} region is indicative of C=C point of unsaturations, which is also seen in the infrared spectra of the Brominated Corn Oil as observed in Table 3 below. Evidence to confirm that bromination has occurred, is the sharp weak absorption of carbon-bromine bond at 600cm^{-1} Table 3), and its absence in that of CO in table 3. Presence of some targeted functional groups like the carbonyl stretch 1750cm^{-1}, 1400cm^{-1} for C-O ester and 1660 to 1680cm^{-1} for C=C alkene were observed in both infrared spectra of CO and BCO (Tables 2&3). The alkene bond that is present in BCO is probably due to incomplete bromination of CO, C=C bonds.

Sample	Absorption Frequency (cm^{-1})	Types of Bond	Remark
Corn Oil	**3050**	**C-H Stretch**	**Alkene**
	2950	**C-H Stretch**	**CH_3-**
	2890	**C-H Stretch**	**-CH_2-**
	2850	**C-H Stretch**	**-CH-**
	1800	**-C=O Stretch**	**Carbonyl**
	1680	**-C=C Stretch**	**Alkene**
	1400	**C-O- Stretch**	**Ester**

Table 2: Infrared Spectra of Corn Oil (CO)

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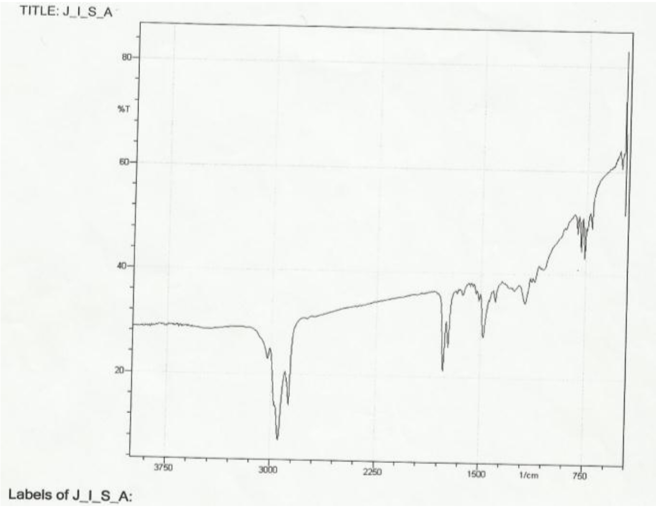

Figure 1: Infrared spectra sheet of Corn oil

Sample	Absorption Frequency (cm^{-1})	Types of Bond	Remark
Brominated Corn Oil	**2900**	**C-H Stretch**	**CH_3- and -CH_2-**
	2850	**C-H Stretch**	**-CH-**
	1750	**C=O Stretch**	**Carbonyl**
	1400	**C-O- Stretch**	**Ester**
	1680	**-C=C Stretch**	**Alkene**
	600	**C-Br Stretch**	**C-Br Bond**

Table 3: Infrared Spectra of Brominated Corn Oil (BCO)

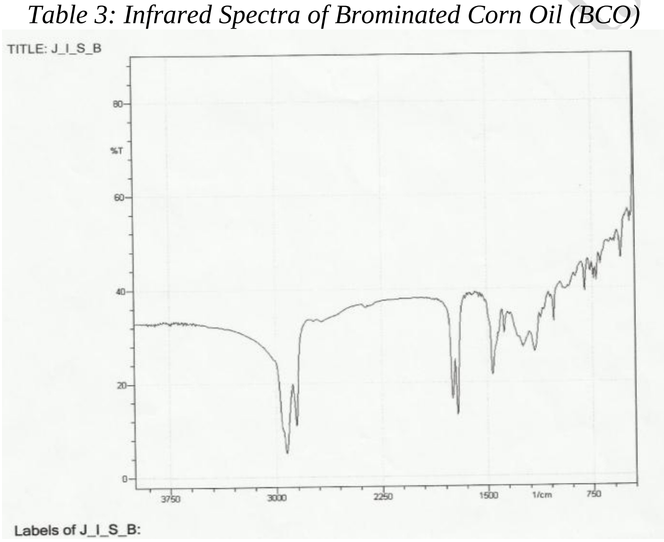

Figure 2: Infrared spectra sheet of Brominated Corn Oil.

BCO showed a broad activity against Escherichia coli, salmonella sp, staphylococcus aureus and streptococcus epidermidis micro organism which gave the inhibition zones of 17 mm, 16.5 mm, 15 mm and 16.0 mm respectively; with better activity than CO. Dimethylsulphoxide (DMSO) was used as the negative control and Streptomycin as the positive control at 400ml/L sample concentration.

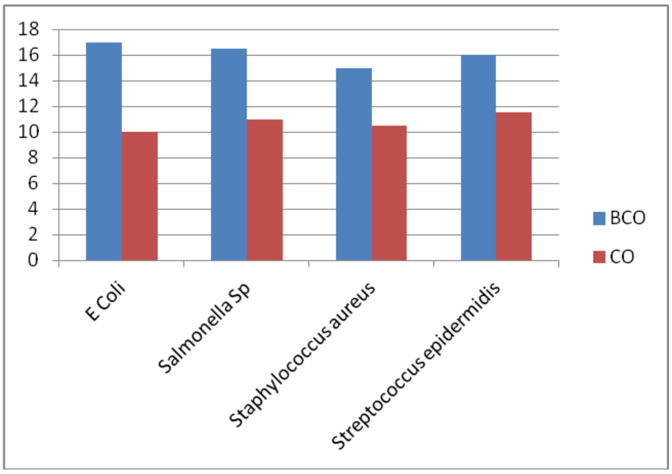

Figure 3: A plot of bacteria against inhibition zones (in mm)

IV. CONCLUSION

Corn oil was successfully extracted and brominated and the oil quality parameters of the corn oil and its brominated derivative determined. Antibacterial activity of the two (CO and BCO) shows activity with the target microbes. BCO showed better activity than CO. Based on the activity of BCO on the target bacteria, we recommend that its exploitation as an antimicrobial agent, in sanitary products such as hand sanitizers or as disinfecting oils be explored.

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