

Original Research Article

Chemical evaluation, Anti-oxidant and Antimicrobial studies of extract of Corn (*Zea may*) silk

ABSTRACT

The leaves and stem bark of Corn **silkis** thought to possess medicinal properties according to Nigerian folklore. This study was undertaken to appraise its phytochemical constituents and anti-microbial activities. Data obtained revealed that alkaloids, flavonoids, tannins, saponins, steroids, glycosides and cardiac glycosides were detected in **the fresh and dry plant samples**. The antioxidant activity of the extracts was determined by the DPPH inhibition method. **The crude stem bark** exhibited a stronger free radical scavenging activity **than that of the leaf** (76.14: 73.54, 75.76: 68.23, 68.18: 61.46 and 64.18: 41.58% for the fresh versus the dried samples at 5, 3, 2 and 1 mg/ml concentrations). Results showed that when tested against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsciella pneumonia*, *Escherichia coli* and *Salmonella thypi*, the zones of inhibition obtained ranged from 10 to 16mm for the fresh samples and between 12 to 20mm for the dried samples. Mineral analysis revealed the presence of calcium (0.1869: 0.0610 mg/g), iron (0.005: 0 mg/g), magnesium (0.1939: 0.0934 mg/g), copper (0.0073: 0.0094 mg/g), manganese (0.0109: 0.0027 mg/g) and zinc (0.0165: 0.0146 mg/g) in the dried immature/mature silk. The results obtained suggested that the **dried Corn silkstudied** plant possess better anti-bacterial activity with the major activity tailored to the phyto-constituents. GCMS analysis of the hexane extract of the silk showed the presences **ofstraight** chain alkanes and poly unsaturated methyl esters.

Keywords: **Pollinated corn silk**, Phytochemicals, Anti-microbial activity, antioxidants

1. INTRODUCTION

Plants and **herbsconstitute** a natural reserve of chemotherapeutic agents towards the deterrence or treatment of various diseases (**Zampiniet al., 2009**). The attention being received in recent times is as a culmination of immune-boosting potential alongside the inhibitory effects of herbal products against several pathogens/microbial agents that plague humans and animals alike (**Bhalodiaet al., 2011; Vashneyet al., 2012; Sharma et al., 2014**).Furthermore, with the increased demand for organic materials that serve as food additives, constituents of functional foods, nutraceuticals, prevention of plant diseases, **etc,**

it is therefore conceivable to examine the applicability and benefits of indigenous plant materials to mankind using modern scientific analysis methods (Abdel Rahman *et al.*, 2011).

Corn silk is the long style and stigma of flower corn or maize (*Zea mays*). They are fine and soft yellowish to green or purple before pollination and maturity and light to dark brown afterwards (figure 1). Fresh un-pollinated Corn silk is used in folkloric medicine (Solihah *et al.* 2012, Jianyou *et al.* 2009). Corn silk has been used in many parts of the world for the treatment of edema as well as for cystitis, gout, kidney stones, nephritis and prostatitis. It is reported to contain proteins, vitamins, carbohydrates, Ca, K, Mg and Na salts, fixed and volatile oils, steroids such as sitosterol and stigmasterol, alkaloids, saponins, tannins, and flavonoids. There have been many reports on the biological activities of Corn silk constituents. Methanol extracts of Corn silk showed an anti-oxidative activity on the level of lipid peroxidation. Volatiles from Corn silk inhibited the growth of *Aspergillus flavus*, indicating that it has an antifungal (Jianyou *et al.* 2009). Currently products such as tea powder and cosmetic from Corn silk are commercially available in China, Korea, Japan and the United Kingdom (Sarepoua *et al.* 2013). From literature review most work done has been focused on the un-pollinated corn silk. (Sarepoua *et al.* 2013, Khairunnisa *et al.* 2012, Solihah *et al.* 2012, Jianyou *et al.* 2009)

The aim of this study was to evaluate the chemical and biological properties of matured pollinated silk with the view of encouraging its use for possible medicinal and other nutritional purposes and ample opportunity of converting this agricultural waste especially in Nigeria to wealth.

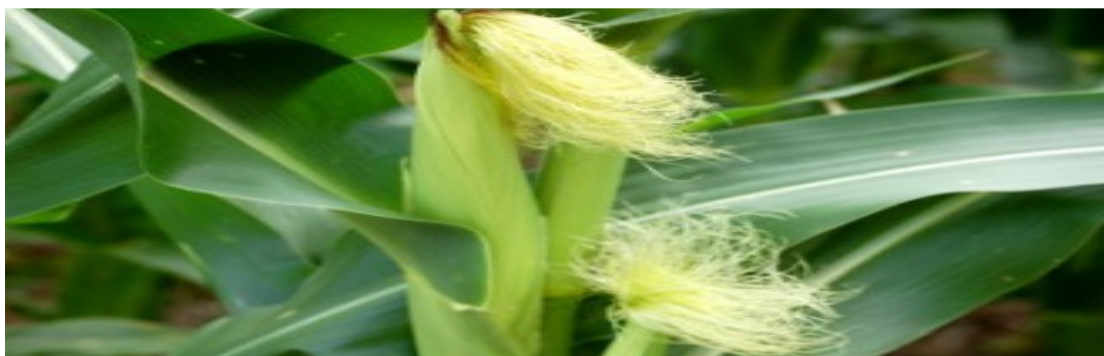


Figure 1. Corn Silk



57 2. MATERIALS AND METHODS

58 Corn **silkwas** collected from the farmers around the complex. The matured **pollinatedCorn**
 59 **silkwas** divided into two groups a portion was air dried and the other half prepared for
 60 extraction. Also a little quantity of un-pollinated **Corn silkwas** gotten for elemental
 61 analysis. The crude extract of the silk sample was collected as described by **Emmanuel et al.**
 62 **(2014)**. The fresh silk and dried silk **weresoaked** in 600ml methanol in 1L beaker respectively
 63 for three days. It was filtered on the third day and the filtrate was concentrated using a
 64 rotary evaporator. This was poured into a 600 cm³ beaker and allowed to dry further on a
 65 water bath. The crude extract was weighed and percentage yield of the extract was
 66 calculated.



67 **All reagent** used for this work are of analytical grade obtained from BDH. They were used
 68 without further purification except where otherwise stated.

69

70 2.1 Phytochemical analysis



71 This analysis was carried out as described by **Emmanuel et al., 2014**; to test for the presence
 72 of phenols, alkaloids, steroids, terpenes, cardiac glycosides, tannins, flavonoids,
 73 anthraquinones, saponins, triterpenoids, glycosides, phlobatannins, resins, **balsamsand**
 74 volatile oils (~~Emmanuel et al., 2014~~).

75

76 2.2 Elemental analysis

77 Two grams of the dry and fresh matured silk was weighed into a beaker. 20 ml of nitric acid
 78 was added to the sample. This was heated on the hot plate at 60°C for 30mins. It was then
 79 removed from heat and allowed to cool. The solution was diluted with distilled deionized
 80 water and made up to 50ml in a volumetric flask. A blank was prepared in the same manner
 81 and poured into a polypropylene bottle. The samples were analysed for metals on Thermo
 82 Scientific *iCE* 3000 AA02134104 atomic absorption spectrometer **usingappropriate** working
 83 standards.

84

85 **2.3 GCMC analysis of hexane extract**

86 Hexane extract of the sample was obtained using soxhelex extractor. This extract was
 87 concentrated using rotary evaporator and the **extractcomposition** analysis was carried out
 88 on Agilent Technology 7890A, 5975C series gas chromatography equipped with FID detector
 89 on a splitless (7683B series) injector. A fused silica capillary column (HP5MS) was used with
 90 the injector and detector temperature maintained at 230°C and 280°C, respectively. The
 91 oven temperature was programmed at 80°C for 2 min and finally increased to 280°C at
 92 6°C/min. The carrier gas was helium at a flow rate of 1.5 mL/min. The area percentages
 93 were recorded with a standard Chemstation Data System.

95 **2.4 Antimicrobial Screening**

96 Antibacterial activities of the **Corn** silkeextracts was tested on Muller Hinton agar, using agar
 97 well diffusion method described by **Kachrooet al. (2011)** and **Gbadamosiet al. (2012)**. The
 98 bacterial isolates were subcultured in peptone water. After 24hrs, the solutions got turbid
 99 and, using spectrophotometer, the turbid solutions were analysed and compared with that
 100 of standard 0.5 McFarland solutions. Using sterile cotton board the suspensions were
 101 stricken on top of the previously sterilized Petri plates with solidified media and was allowed
 102 to dry for 15 minutes. Five wells were punched using sterile cork borer of 6mm size. To test
 103 sensitivity properties of the **Corn silkeextract**, half dilutions of 600, 300 and 150 mg/ml were
 104 prepared from stock solution using Dimethylsuphoxide (DMSO) as a diluent. Each well was
 105 filled with 0.5ml of the different dilutions. A standard antibiotic Ciprofloxacin (30µg/ml) was
 106 used as positive Control, while DMSO served as negative Control. This was done to check for
 107 sterility and any growth inhibitory potential of the solvent. The plates were kept for 1hour
 108 at room temperature to allow diffusion of the extract to take place and then incubated
 109 aerobically at 37°C for 24hours. The zones of inhibition produced by different species were
 110 measured in (mm) across the diameter.

111 **2.5 Scavenging effect on 2,2-Diphenyl-1-picrylhydrazyl radical (DPPH)**

112 This was determined as described **byOlajide et al, 2013**. The radical scavenging activity of the
 113 methanol extract against DPPH (Sigma-Aldrich) was determined by UV-Visible
 114 Spectrophotometer at 517 nm. Radical venging activity (RSA) was calculated as
 115 **percentage inhibition of DPPH discoloration** using the equation below.

$$\% \text{ Inhibition} = \frac{Ab}{Ab} - \frac{Aa}{Ab} \times \frac{100}{1}$$

Where Aa is the absorption of the blank without extract and Ab is the absorption of the extract.

3. RESULTS

The result of phytochemical screening is shown on Table 1. The result showed the presence of metabolites such as alkaloid, flavonoids saponin, tannin, phenol and steroid, glycoside, cardiac glycosides, volatile oil, balsam. The presence of phenol and volatile oil were not observed in the Fresh Matured Corn silkSample (FMCSS) but was present in the Dried Matured Corn silkSample (DMCSS) resin was present only in the FMCSS. Tables 2 and 3 show the result of the antimicrobial screening of the extracts, the activity of the extract against the test organisms showed increase in activity with increasing concentration with the dried silk showing higher activity compared to the fresh silk sample. The result of the mineral analysis is as shown on Table 4. The result showed significant amount of magnesium in the samples, the dried immature silk showing the highest quantity. The same trend is observed for the other minerals analysed in the samples. The anti-oxidant activity of the extract is shown of Table 5. The result showed an increase in scavenging activity with increase in concentration of the sample extract.

Relevant data of the GCMS analysis of the hexane extract is shown on Table 6. The peaks between 16 and 38 minutes were considered, compounds identified from the chemstation data are 1,2benzenedicarboxylic mono(2-ethylhexyl ester), nonacosane, octacosane, heptacosane, octadecanodioic acid, tetracosanoic acid and hexadecanoic acid.

Table 1: Result of phytochemical screen of extract of FMCSS and DMCSS

Test	FMCSS	DMCSS
Tannin	+	+
Saponin	+	+
Steroid	+	+
Triterpenoid	-	-
Alkaloid	+	+
flavonoid	+	+
Phenol	-	+
Terpenoid	-	-
Glycoside	+	+
Cardicglycosides	+	+
Volatile oil	-	+

Phlobatannin	-	-
Cardenolides	-	-
Balsams	+	+
Resin	+	-

Table 2: Antimicrobial Activity of Methanolic Extract of FMCSS

Microorganism	Zone of Inhibition in mm and extract Concentrations in mg/ml				
	(600mg/ml)	(300mg/ml)	(150mg/ml)	Positive Control Ciprofloxacin (30µg/ml)	Negative Control DMSO
<i>Pseudomonas aeruginosa</i>	14.00	11.00	08.00	23.00	NA
<i>Salmonella typhi</i>	10.00	07.00	-	23.00	NA
<i>Escherichia coli</i>	14.00	10.00	07.00	23.00	NA
<i>Klebsiella pneumonia</i>	13.00	11.00	08.00	23.00	NA
<i>Staphylococcus aureus</i>	16.00	13.00	09.00	25.00	NA

Table 3: Antimicrobial Activity of Methanolic Extract of DMCSS

Microorganism	Zone of Inhibition in mm and extract Concentrations in mg/ml				
	(600mg/ml)	(300mg/ml)	(150mg/ml)	Positive Control Ciprofloxacin (30µg/ml)	Negative Control DMSO
<i>Pseudomonas aeruginosa</i>	16.00	13.00	10.00	23.00	NA
<i>Salmonella typhi</i>	12.00	09.00	07.00	23.00	NA
<i>Escherichia coli</i>	15.00	12.00	09.00	23.00	NA
<i>Klebsiella pneumonia</i>	16.00	14.00	11.00	23.00	NA
<i>Staphylococcus aureus</i>	20.00	16.00	12.00	25.00	NA

Table 4: Elemental analysis

Element mg/g	Fresh matured silk	Dried immature silk	Dried matured silk
Ca	0.1465	0.1869	0.0610
Mg	0.1602	0.1939	0.0934
Cu	0.0072	0.0073	0.0094
Fe	0.0198	0.005	B.D.L
Mn	0.0187	0.0109	0.0027
Zn	0.0136	0.0165	0.0146

Table 5: Result of anti-oxidant analysis

Concentration mg/ml	% inhibition for Vit C	% inhibition for FMSS	% inhibition for DMSS
5	85.00	76.14	73.54
3	90.15	75.76	68.23
2	90.41	68.18	61.46
1	91.50	64.18	41.58
0.5	91.32	45.89	37.66
0.1	90.47	29.68	28.54
0.05	90.19	31.77	26.14

Table 6: Relevant GCMS analysis chromatogram data

Peak No	Retention Time (RT)	Peak Height	% of Total
1.Hexadecanoicacid	ME 16.770	2694303	0.752
2.	18.491	3989276	1.020

9,12,octadecadienoic acid	ME			
3. 11-octadecenoic acid	ME	18.546	2721710	0.853
4. Octadecanoic acid	ME	18.778	1640635	0.370
5. 1,2-Benzenedicarboxylic acid, mono(2-ethylhexyl)ester		23.732	11394452	11.089
6. Heptacosane		26.473	3689788	2.688
7. Tetracosanoic acid,	ME	27.209	1082364	0.797
8. Octacosane		29.065	992794	0.808
9. Nonacosane		32.963	3694808	9.958
		33.065	434105	

KEY: ME ----- methyl ester

4. DISCUSSION

The therapeutic value of medicinal plants has been explored towards the treatment of many types of ailments particularly in developing countries. The use of such plants is being boosted by the notion that plant-based drugs are not commonly linked with certain side effects associated with the use of synthetic drugs. Active compounds within plants are now screened to unveil the endless possibilities for their antagonistic nature against a host of microbial agents of disease, thereby positioning them as ideal drug candidates. Furthermore, this serves to validate the claim according to folklore that indigenous plants are being used for traditional African medicinal practices (Mannet *al.*, 2008). The therapeutically and dietary needs that specific native plant species meet has been underscored in many developing countries (Edeogaet *al.*, 2005).

In this study, the detection of certain phyto-compounds would augment the curative potential of the plant against several pathogens (Hassan *et al.*, 2004; Usman *et al.*, 2007). Analysis of the data obtained from table 1 suggests that both extracts contained certain compounds including alkaloids, flavonoids, tannins, saponins, steroids, glycosides and cardiac glycosides. For instance, plant glycosides and cardiac glycosides possess herpato-stimulatory activity thus making them useful for increasing heart muscles contractions as well as in cancer treatment (Afaqet *al.*, 2004; Newman *et al.*, 2006). Towards the treatment of extreme upper respiratory tract infections, the administration of aminoglycoside antibiotics; streptomycin and kanamycin, are of importance as these in combination with other similar drugs is used for treating pneumonia and brucellosis (Lawn and Wilkison, 2006;

169 Furin, 2007). The presence therefore of both glycosides and cardiac glycosides in the
 170 extracts of the studied plants gives a good indication that these plants may possess
 171 important bioactive compounds of different antibiotic class. DMCSS contain all Phenolics;
 172 Flavonoids, Phenols and Tannins. As a group, these are some of the most abundant phyto-
 173 constituents in plants and has also been associated with good mental performance through
 174 the consumption certain food and processed items such as berries, chocolate, red wine and
 175 tea (Nurket *al.*, 2009). Furthermore, the anti-septic nature of phenolics suggests that this
 176 plant extract should possess good antimicrobial activity against a selected range of
 177 organisms. The success in treating diarrhoea and stomach upsets, attributed to
 178 *Staphylococcus aureus* and *Salmonella spp* infections could be due to the antibacterial
 179 effects of alkaloids, polyphenols, saponins and steroids (Vieira *et al.*, 2001).
 180 Distorting the enzyme activity within bacteria is usually observed in the presence of phyto-
 181 tannins (Sallau *et al.*, 2005). The anti-diarrheal effectiveness of alkaloids is reportedly potent
 182 against intestinal infections associated with AIDS, thereby linking the screening of plants
 183 with a high presence of alkaloids to the treatment of HIV infections (Cowan, 1999). Other
 184 phyto-constituents observed included saponins which alongside alkaloids are known to be
 185 very effective against both gram positive and gram bacteria such as *Salmonella spp* and
 186 *Streptococcus spp* (Iwu *et al.*, 1999), used in this study. In this report, the respective fresh and
 187 dried extracts of Corn silk was tested against different microorganisms in an attempt to
 188 gauge their activity spectrum. The varied antimicrobial activity depicted (tables 2&3) is
 189 indicative of the antibacterial compounds present, thereby supporting the data obtained
 190 from the phytochemical studies (table 1).
 191 Reports indicate that Corn silk have been employed therapeutically towards the
 192 amelioration of cystitis, edema, kidney stones, diuretic, prostate disorder, and urinary
 193 infections as well as bedwetting and obesity (Hu *et al.*, 2010). Also, it is known to exhibit for
 194 strong antioxidant capacity (Ebrahimzadeh *et al.*, 2008).
 195 It has been determined that phenolic compounds; particularly the flavonoids and
 196 anthocyanins are the most commonly found phytochemicals present in Corn silk thus
 197 suggesting that the plant possesses an inherent range of bioactive abilities (Maksimovic *et*
 198 *al.*, 2005; Sarepoua *et al.*, 2013).
 199 In a study by Solihah and co-workers, (Solihah *et al.*, 2012), phenols, flavonoids, tannins,
 200 phlobatannins, alkaloids, saponins and cardiac glycosides were detected in both aqueous

201 and methanolic extracts of **Corn silkin** which the methanolic extracts alone contained
202 terpenoids. The data from that report is similar to that obtained in this study.

203 Disease causing pathogens like *Pseudomonas aeruginosa* and *Staphylococcus aureus* are two
204 of the most opportunistic infections commonly associated with respiratory diseases, urinary
205 tract and gastrointestinal infections, etc (Trautmann *et al.*, 2008; Akoachere *et al.*, 2012) that
206 have gained a lot of attention owing to its raising prevalence among community acquired
207 infections. Another contender for significant opportunistic infections is *Escherichia coli*,
208 which has been identified among the array of causative agents responsible for acute
209 diarrhoea and other urinary tract infections globally (Darwish and Aburjai, 2010).

210 The antimicrobial activity depicted is indicative of the antibacterial compounds present,
211 thereby supporting the data obtained from the phytochemical studies (table 1). The result
212 indicates that the polar fraction of the extract possess reasonable activity against gram
213 positive and gram negative bacteria, thereby demonstrating the potential of the plant to be
214 used in curing diseases caused by these organisms. The data revealed that the extracts were
215 general effective against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsciella*
216 *pneumonia*, *Escherichia coli*, and *Salmonella thypi* with zones of inhibition ranging from 10-
217 16±0.50mm for the fresh samples and 12-20 ±2.50mm for the dried samples respectively
218 tested against Ciprofloxacin. Both FMCSS and DMCSS were most effective against
219 *Staphylococcus aureus*. The mineral analysis result (table 4) indicated the presence of
220 calcium (Ca), iron (Fe), magnesium (Mg), copper (Cu), manganese (Mn), and zinc (Zn) which
221 were all higher in the dried immature sample than either of the two other prepped samples
222 tested. The concentrations of the essential elements appear to be within the WHO
223 approved permissible limit for minerals consumed therapeutically as well as for general
224 human health (WHO, 1996). From the data, the plant is useful towards bone formation,
225 energy, normal functioning of metabolic and metallo-enzymes. The presence of zinc and
226 other trace minerals further boosts the plants' application as an anti-microbial agent.

227 Analysis of its anti-oxidant potential (table 5) suggests that presence of certain phyto-
228 compounds particularly flavonoids in concert with other compounds, triggers it free radical
229 scavenging (FRSA) activities. The FRSA of the samples were determined as 76.14: 73.54,
230 75.76: 68.23, 68.18: 61.46 and 64.18: 41.58% for the fresh versus the dried samples at
231 5,3,2 and 1 mg/ml concentrations (table 5). This result is high for plants in comparison to
232 the synthetic standards of vitamin C which gave 85.00%, 90.15%, 90.41% and 91.50%

respectively at the same concentrations. The presence of key enzymes and catalytic agents in plant samples aids in quelling the lethal effects of reactive oxygen species to the body. Their ability to suppress free radicals before they can attack the cells and biological targets, prevents impairment to carbohydrates, DNA, enzymes, lipids and proteins (Fang *et al.*, 2002).

5. CONCLUSION

This study serves to authenticate the indigenous customs in developing countries in addition to contributing further depths to the growing literature on plant materials recognized as a reservoir of unique compounds. Furthermore, the awareness of the therapeutic effect of this plant in the treatment of different bacterial infections seems to be well known in some Nigerian cultures. The findings in this study have hence provided scientific support for the ethnomedical anti-bacterial activity of particularly dried extracts of matured Corn silk, when compared to using the standard drug (Ciprofloxacin). The phyto-chemistry of the plant shows that the extracts contain alkaloids, flavonoids, tannins, saponins, steroids, glycosides and cardiac glycosides. Hence the range of pharmacologic activities could be deduced from the above phyto-constituents.

REFERENCE

- Bhalodia NR, and Shukla VJ. Antibacterial and antifungal activities from leaf extracts of *Cassia fistula* L.: An ethnomedicinal plant. *Journal of Advanced Pharmaceutical Technology and Research*. 2011;2(2):104-109. DOI: 10.4103/2231-4040.82956
- Vashney S, Vashney P, Dash SK, Gupta MK, Kumar A, Singh B, and Sharma A, (2012). Antibacterial activity of fruits of *Terminalia chebula* and *Terminalia bellerica* against mastitis field isolates. *Medicinal plants*, 4: 167-169.
- Sharma AK, Kumar A, Yadav SK, and Rahal A, (2014). Studies on antimicrobial and immunomodulatory effects of hot aqueous extract of *Acacia nilotica* L. leaves against common veterinary pathogens. *Veterinary Medicine International*, 10.1155/2014/747042.

- 265 • Zampini IC, Cuello S, Alberto MR, Ordonez RM, Almeida RD, Solorzano E and Isla MI (2009).
 266 Antimicrobial activity of selected plant species from the Argentine Puna against sensitive
 267 and multi-resistant bacteria. *Journal of Ethanopharmacology*, 124: 499-505.
 268
- 269 • Abdel Rahman S, Abd-Ellatif S, Deraz S, and Khalil A, (2011). Antibacterial activity of some
 270 wild medicinal plants collected from western Mediterranean coast, Egypt: Natural
 271 alternatives for infectious disease treatment. *African Journal of Biotechnology*, 10: 10733-
 272 10743.
 273
- 274 • JianyouGuo, Tingjun Liu, Linna Han and Yongmei Liu; (2009); The effect of Corn
 275 *silkonglyceamicmetaboloism. Nutrition & Metabolism 2009*, 6:47 doi:10.1186/1743-7075-6-
 276 47
 277
- 278 • Sarepoua, E., Tangwongchai, R., ,3Suriharn, B. and Lertrat, K. (2013); Relationships between
 279 phytochemicals and antioxidant activity in corn silk; *International Food Research Journal*
 280 20(5): 2073-2079
 281
- 282 • Emmanuel S.A, OlajideO.O,AbubakarS., Idowu I.D,OrishadipeA.T and Thomas S.A
 283 (2014);Phytochemical and Antimicrobial Studies ofMethanol, Ethyl acetate, and
 284 Aqueous Extracts of *MoringaoleiferaSeedsAmerican Journal of Ethnomedicine*, Vol. 1,
 285 No. 5, 346-354
 286
- 287 • KachrooVipin, Gupta Kumar Arun, Gupta Rajesh (2011). Antimicrobial Activity of
 288 Sesbaniagrandiflora (L) PERS. *International Research Journal of Phamacy*, 2(7);85-87.
- 289 • Gbadamosi I. T. Alia A. E. and Okolosi O. (2012). *In-vitro* Antimicrobial Activities and
 290 Nutritional Assessment of Roots of Ten Nigerian Vegetables, New York Science journal
 291 2012;5(12).
 292
- 293 • FazilatunNessa, Zhari Ismail and Nornisah Mohamed (2012). Antimicrobial Activities of
 294 Extracts and Flavonoid Glycosides of Corn *silk(Corn silkL). International Journal of*
 295 *Biotechnology for Wellness Industries*, (1), 115-121
 296
- 297 • Olajide O, Orishadipe A, Fatokun O, akande T, and Iliya I. the chemical composition of
 298 essential oil from the root of *Cissampelosowariensis*(P.beauv) and free radical scavenging of
 299 its extract. *African Journal of Pure and Applied chemistry* 2013, 7(9)225-230.
 300
- 301 • Mann, A., Bansa, A., and Clifford, L. C. (2008). An antifungal property of crude plant extracts
 302 from *Anogeissusleiocarpus*and *TerminaliaAvicennnioides.Tanzanian Journal of Health*
 303 *Research*, 10: 34-38.
 304

- 305 • Edeoga HO., Okwu DE., and Mbaebie O., (2005). Nutritional Values of some known
 306 conventional leafy vegetables of Nigeria. *African Journal of Biotechnology*, **4**: 685-688.
 307
- 308 • Hassan MA., Oyewale AO., Amupitan JO., Abdullahi MS., and Okonwo EM., (2004).
 309 Preliminary phytochemical and antimicrobial investigation of crude extract of root bark of
 310 *Deteriummicrocarpum*. *Journal of chem. Sci. Niger*, **29**: 36-49.
 311
- 312 • Usman H., AbdulrahmanFK., and Ladan AA., (2007). Phytochemical and Antimicrobial
 313 Evaluation of *Tributus. L. (Zygophyllaceae)* Growing in Nigeria. *Res. J. Biosc. Medwell* **J.2**: 244-
 314 247.
 315
- 316 • Afaq F., Saleem M., Aziz MH., and Mukhtar H., (2004). Inhibition of 12-O-
 317 tetradecanoylphorbol-13-acetate-induced tumor promotion markers in CD-1 mouse skin by
 318 oleandrin. *Toxicology and Applied Pharmacology*, **195**:361-369.
 319
- 320 • Newman RA., Yang P., Hittelman WN., Lu T., Ho DH., Ni D., Chan D., Vijeswarapu M.,
 321 Cartwright C., Dixon S., Felix E., and Addington C., (2006). Oleandrin-mediated oxidative stress
 322 in human melanoma cells. *Journal of Experimental Therapeutics and Oncology*, **5**, 167–181.
 323
- 324 • Lawn SD., and Wilkinson R., (2006). Extensively Drug Resistant tuberculosis. *British Medical*
 325 *Journal*, **55**: 301-305.
 326
- 327 • FurinJJ., (2007). The clinical management of drug-resistant tuberculosis. *Current opinion in*
 328 *pulmonary medicine*, **13**: 212–217.
 329
- 330 • Nurk E., Refsum H., Drevon CA., Tell GS., Nygaard HA., Engedal K., and Smith AD., (2009).
 331 *Intake* of flavonoid-rich wine, tea, and chocolate by elderly men and women is associated
 332 with better cognitive test performance. *Journal of Nutrition*, **139**: 120–127
 333
- 334 • Vieira RHSF., Rodrigues DP., Goncalves FA., Menezes FGR., Aragao JS., and Sousa OU.,
 335 (2001). Microbial effect of medicinal plant extracts (*Psidiumguajavalinn* and *Carica papaya*
 336 *linn*) upon bacteria isolated from fish muscle and known to induce diarrhoea in children.
 337 *Revistadeinstitute de medecina tropical de Sao Paulo*, **43**: 145-148.
 338
- 339 • Sallau AB., Njoki GC., Olokisi AR., Wurochekke AU., Abdulkadir AA., Isah S., Abubakar MS.,
 340 and Ibrahim S., (2005). Effects of *Guierasenegalinsis* leaf extracts on some
 341 *Echiscarinatus* venom enzymes. *Journal of Medicinal Science*, **5**: 2880-2883
 342
- 343 • Cowan MM., (1999). Plant products as antimicrobial agents. *Clinical Microbiology reviews*
 344 **12**: 564-582
 345

- 346 • IwuMM., Angela RD., and Chris O., (1999). New microbials of plant origin in J. Janick (ed)
 347 Perspective on crops and their uses. ASHS press Alexandria, pp 457–462
 348
- 349 • Hu, Q.L.; Zhang, L.J.; Li, Y.N.; Ding, Y.J.; Li, F.L. Purification and anti-fatigue activity of
 350 flavonoids from corn silk. *Int. J. Phys. Sci.* **2010**, *5*, 321–326.
 351
- 352 • Ebrahimzadeh, M.A.; Pourmorad, F.; Hafe, S. Antioxidant Activities of Iranian Corn *Silk. Turk.*
 353 *J. Biol.* **2008**, *32*: 43–49.
 354
- 355 • Maksimovic, Z., Malencic, D., and Kovacevic, N., (2005). Polyphenol contents and antioxidant
 356 activity of *Maydis stigma* extracts. *Bioresource Technology* **96**: 873–877.
 357
- 358 • Sarepoua, E., Tangwongchai, R., Suriharn, B., and Lertrat, K., (2013). Relationships between
 359 phytochemicals and antioxidant activity in corn silk. *International Food Research Journal*, **20**:
 360 2073-2079.
 361
- 362 • Solihah, M.A., wan Rosli, W.I. and Nurhanan, A.R., (2012). Phytochemicals screening and total
 363 phenolic content of Malaysian Corn silkhair extracts. *International Food Research Journal*, **19**:
 364 1533-1538.
 365
- 366 • Trautmann M., Halder S., Hoegel J., Royer H., and Haller M., (2008). Point-of-use filtration
 367 reduces endemic *Pseudomonas aeruginosa* infections on a surgical intensive care unit.
 368 *American Journal of Infection Control*. **36**: 421-429
 369
- 370 • Akoachere J-FTK., Suylika Y., Njom HA., and EsemuNK., (2012). Etiologic profile and
 371 antimicrobial susceptibility of community acquired urinary tract infection in two
 372 Cameroonian towns. *BMC Research Notes*, **5**: 219
 373
- 374 • DarwishR., and AburjaiAT., (2010). Effect of ethnomedicinal plants used in folklore medicine
 375 in Jordan as antibiotic resistant inhibitors on *Escherichia coli*. *BMC Complementary and*
 376 *Alternative Medicine*, **1**-8
 377
- 378 • WHO (1996) Guidelines for elemental concentration, trace elements in health and human
 379 nutrition
 380
- 381 • Fang Y., Yang S., and Wu G., (2002). Free radicals, antioxidants, and nutrition. *Journal of*
 382 *Nutrition*, **18**: 872-879.
 383
- 384 • KhairunnisaHasanudin, PuziahHashim and Shuhaimi Mustafa(2012); Corn Silk (*Stigma*
 385 *Maydis*) in Healthcare: A Phytochemical and Pharmacological Review; *Molecules*, **17**, 9697-
 386 9715; doi:10.3390/molecules17089697