Anionic Schiff Base Amphiphiles: Synthesis, Surface, Biocidal and Antitumor Activities

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Abstract: A series of anionic surfactants containing schiff base group was synthesized and their chemical structures were confirmed using elemental analyses, FTIR, ^{1}H-NMR, and mass spectroscopy. The surface activities of these amphiphiles were determined based on the data of surface tension. Thermodynamics of adsorption and micellization processes of these surfactants in their solutions were also calculated. It was found that these compounds have tendency towards adsorption at the interface and also micelle formation at lower concentrations.Also, these schiff bases amphiphiles have been evaluated for their biocidal activity against bacterial and fungi species and their antitumor activity against three human tumor cells such as $HEPG_2$ (liver), HCF_7 (breast) and HCT116 (colon).

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1. Introduction:

Schiff bases are one of the important classes of organic compounds which have many interesting properties and extensive applications in medicinal, agricultural, pharmaceutical fields and material science (Cerchiaro *et al. 2005,* Vancoa *et al*. 2004, Marcell *et al*.2009, Nabel and Mohamed 2008). Schiff bases are characterized by the –N=CH– (imine) group which is important in elucidating the mechanism of transamination and racemisation reactions in biological systems (Lau *et al*. 1999 and Shawal *et al.*1985). Due to the great flexibility and diverse structural aspects, a wide range of Schiff bases have been synthesized. Now days, there is a large number of research on Schiff base amphiphiles have already been published. The most ones were used as corrosion inhibitors and crude oil spill dispersants (Aiad et *al.*2009, Negm *et al*.2008, Hegazy 2009, Negm *et al*.2009, Nabel *et al*. 2008 ,Atta *et al.*2008, Atta *et al.*2008 and El-Saeed *et al*.2008

Schiff bases are considered good bases for synthesis of several antibacterial compounds due to their easily preparing procedures and their ability to attach to several functional groups on their chemical skeleton. The schiff bases were essentially appeared antibacterial influence against most of bacterial strain, and their resistance routes against different types of bacteria is based on using efficient biocides. These biocides are either cationic, ionic compounds or metal complexes. A literature survey showed that Schiff bases and their metal complexes have biological application including antibacterial (Abdallah *et al*.2009, Nabel *et al*.2008, Nabel *et al.* 2010, Nair *et al*.2006, Raman *et a*l.2003 and Mohamed 2006), antifungal and antitumor activities (Karthlkeyan *et al.*2006 , Gaballa *et al.*2007 , Sinha *et al*.2008 , Weber *et al*.1988 and Baihalli *et al*.2008).

Our study aimed to synthesis some Schiff base surfactants from condensation of three amines with 2-alkoxy benzaldehyde having hydrocarbon chain length ranged from C_{12} to C_{18}. .The prepared compounds were tested for being surface, biocidal and antitumor activities.

The synthetic route, chemical structures and abbreviations of these surfactants are shown in scheme 1.

2. Experimental:

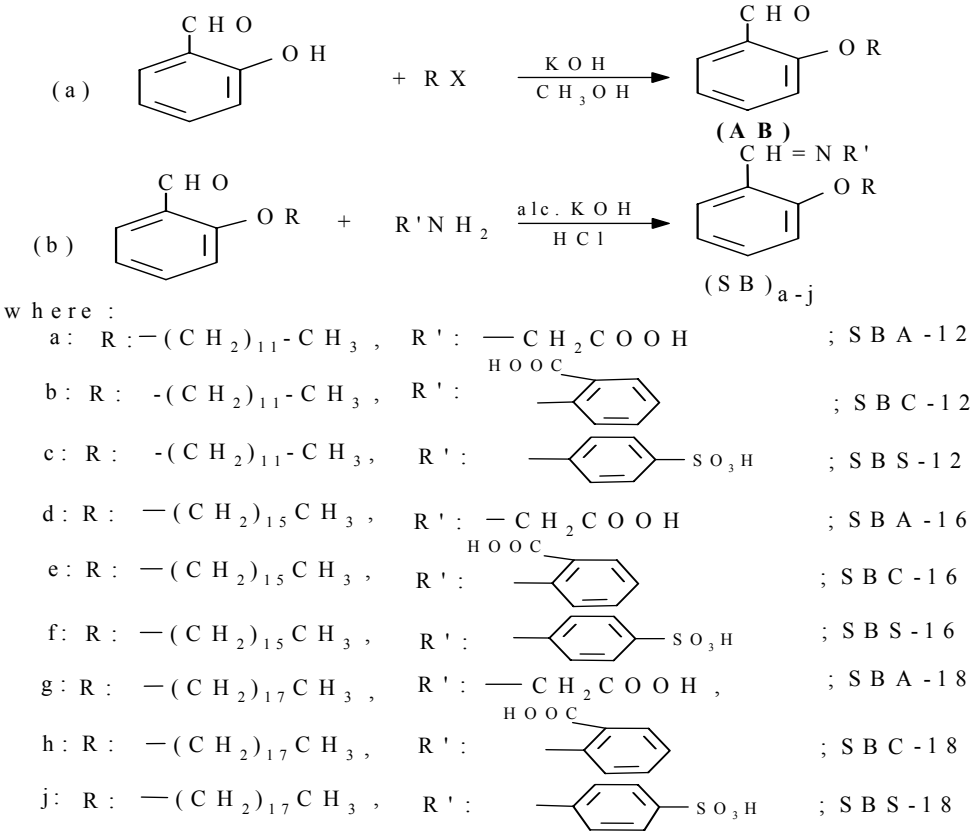
All chemicals used in the present study were of Analar or highest purity grade from BDH, Aldrich and Merck companies and used as received without further purification. FTIR spectra were recorded on a Perkin–Elmer 1420 spectrometer and a biorad FT57 (KBr).A brucker model DRX-300 NMR spectrometer with TMS as an internal standard for ^{1}H-NMR spectra was used. Mass spectra were recorded on a Joel JMS-AX 500 (ET and FAB) $^+$. The elemental analyses of the synthesized materials were performed using a vario Elementar instrument for elemental analysis.

2.1. Synthesis of Alkyl Chloride:

Alkyl chlorides were synthesized according to a method reported elsewhere (Weil *et al.*1960).

2.2. Synthesis of 2-Alkoxy Benzaldehyde (AB):

Salicylaldehyde (20 mmol) was dissolved in methanol (30 ml) containing potassium hydroxide (23 mmol) and the reaction mixture was refluxed under nitrogen atmosphere for 2h. A methanol solution containing (30 mmol) of alkyl chloride was added drop wise to this mixture and refluxed for 20 h under nitrogen atmosphere, scheme 1. The solution was concentrated to dryness to give 2-alkoxy benzaldehyde, AB as red brown viscous oil. The crude product was washed by a mixture of light petroleum; ethyl acetate: chloroform (30: 1: 5 v/v/v) afford AB-12, AB-16 and AB-18 as very viscous liquid (65-80%), Table 1. IR spectrum (AB-12): 721-756 cm^{-1} (Ar-nucleus), 1161 (C–O–C), 1732 (C=O), 2857 and 2923 cm^{-1}(CH_2 and CH_3 of fatty chain). ^{1}H-NMR ($CDCl_3$, MHz): 0.85 (t, 3H, CH_3); 1.04-1.43(m, 22H, $(CH_2)_{11}$); 3.4-3.6(t, 2H, OCH_2); 6.41-7.53 (m, 4H, Ar) and 8.26 (s, 1H, CHO).FAB- MS (m/z): 290 (M^+, 57%).



Scheme 1: Synthetic Route of Schiff Base Amphiphiles.

2.3. Synthesis of Schiff Bases Amphiphiles:

Different alkoxy schiff bases were synthesized by the condensation reaction of amines, namely: glycine, anthranilic and sulfanilic acids with 2-alkoxy benzaldehyde. An amine (3.6 mmol) was stirred with an alcoholic potassium hydroxide solution (17 ml, 3.6 mmol). To this solution, 2-alkoxybenzaldehyde (3.6 mmol) was added drop wise and the reaction mixture was refluxed with continuous stirring for 6hr. Then, the reaction mixture was left to overnight and acidified with dilute hydrochloric acid. The pure schiff base was extracted ethyl acetate and washed several times with water, then dried over anhydrous sodium sulfate to afford the desired Schiff base amphiphiles which were denoted as SBA-12, SBA-16, SBA-18, SBC-12, SBC-16, SBC-18, SBS-12 ,SBS-16 and SBS-18; Scheme 1 and Table 1.

Micro elemental analysis of the synthesized Schiff bases showed their purity (Table 1). IR spectra of SBA-12 showed absorption band at 617-754 cm^{-1} for benzene nucleus and appearance of a strong band

Table 1: Physico-chemical Properties of the Synthesized Compounds:

Compound	Abbreviation	Mol. Formula/Mol. Wt.	Yield%	Microlemental analysis cal./found			
				C	H	N	S
Parent aldehyde; 2-alkoxy benzaldehyde(AB):							
2-dodecyloxybenzaldehyde	**AB-12**	$C_{19}H_{30}O_2$ 292.59	65.2	78.00 77.98	11.09 11.07	- -	- -
2-hexadecyloxy benzaldehyde	**AB-16**	$C_{23}H_{38}O_2$ 349.20	70.6	79.11 79.08	11.77 11.75	- -	- -
2-octadecyloxy benzaldehyde	**AB-18**	$C_{26}H_{42}O_2$ 377.60	80.4	79.53 79.51	12.03 12.01	- -	- -
Schiff base amphiphiles(SB):							
2-dodecyloxy (benzylidene imine) acetic acid	**SBA-12**	$C_{21}H_{33}O_3N$ 347.00	70.1	72.11 72.09	10.20 10.18	4.02 4.00	- -
2-hexadecyloxy (benzylidene imine) acetic acid	**SBA-16**	$C_{25}H_{41}O_3N$ 403.00	82.3	73.88 73.86	11.01 10.89	3.46 3.44	- -
2-octadecyloxy (benzylidene imine) acetic acid	**SBA-18**	$C_{27}H_{45}O_3N$ 427.00	85.6	74.58 74.56	11.19 11.17	3.23 3.21	- -
2-dodecyloxy (benzylidene imine) benzene-1- carboxylic acid	**SBC-12**	$C_{26}H_{35}O_3N$ 412.06	78.6	75.80 75.78	9.18 9.17	3.41 3.39	- -
2-hexadecyloxy (benzylidene imine) benzene-1-carboxylic acid	**SBC-16**	$C_{30}H_{43}O_3N$ 368.47	80.7	76.88 76.86	9.92 9.90	3.00 2.97	- -
2- octadecyloxy (benzylidene imine) benzene-1-carboxylic acid	**SBC-18**	$C_{32}H_{47}O_3N$ 497.08	85.3	77.34 77.32	10.23 10.19	2.84 2.81	- -
2-dodecyloxy (benzylidene imine) benzene-4-sulfonic acid	**SBS-12**	$C_{25}H_{35}O_4NS$ 445.00	75.02	67.03 67.01	8.46 8.44	3.14 3.12	7.16 7.14
2-hexadecyloxy (benzylidene imine) benzene-4-sulfonic acid	**SBS-16**	$C_{29}H_{43}O_4NS$ 501.00	84.3	69.03 69.01	9.23 9.20	2.79 2.77	6.36 6.34
2-octadecyloxy (benzylidene imine) benzene-4-sulfonic acid	**SBS-18**	$C_{31}H_{47}O_4NS$ 529.00	87.8	69.86 69.85	9.54 9.52	2.65 2.63	6.02 6.00

at 1651 cm^{-1}determines the formation of an azomethene (HC=N–). A broad absorption band of C=O appeared at 3425cm^{-1} and at 1701 cm^{-1} for C–O. ^{1}HNMR ($CDCl_3$) for SBA-12: δ 0.88 (t, 3H, CH_3); 1.26 (m, 22H, $(CH_2)_{11}$); 6.59 (d, 4H, Ar); 4.8 (t, 2H, OCH_2); 4.17 (s, 2H, NCH_2); 9.8 (s, 1H, CH=N) and δ 10.5 (s, 1H, COOH). EI/FAB$^+$ (m/z):343(M^+–4, 69.6%).

IR spectra of SBC-12 showed a complete disappearance of the absorption band at 1732 cm^{-1} corresponding to the carbonyl group and the appearance of a new band at 1635cm^{-1} corresponding to C=N group. Bands at 1716, 2869 and 2925cm^{-1} corresponding to C=O of COOH, CH_2 and CH_3, respectively. A broad absorption band at 3440 cm^{-1} for COOH and 621-756cm^{-1} corresponding to a benzene nucleus appeared in all of the synthesized compounds indicating the presence of all functional groups expected in the synthesized compounds. ^{1}HNMR ($CDCl_3$) for SBC-18 showed the following signals relative to TMS as an internal standard at 0.85 (t, 3H, CH_3); 1.12 (m, 22H, $(CH_2)_{11}$); 1.5-1.8 (t, 2H, CH_2); 3.1-3.5 (m. 2H, OCH_2CH_2); 3.6-3.7 (t, 2H, OCH_2); 7.0-7.2 (m, 8H, 2Ar nucleus), 8.4 (s, 1H, CH=N) and δ 10.6 (s, 1H, COOH). The mass spectra showed parent ion peak at m/z (493; M^+–4, 20.2%).

IR spectra of SBS-12 showed a stretching vibration at 1600 cm^{-1} for HC=N and appearance of absorption band for SO_3H and C–O–C at 1207,1110cm^{-1}, respectively, plus all chaired band appeared either in SBA-12 or SBC-12. The chemical shifts of the different types of protons in ^{1}HNMR spectra of SBS-12 showed δ 0.88 (t, 3H, CH_3); 1.24 (m, 22H, $(CH_2)_{11}$); 7.1-7.5 (m, 8H, 2Ar); 8.2 (s, 1H, CH=N); 3.6 (t, 2H, OCH_2) and δ 4.3 (s, 1H, SO_3H). Mass spectra of SBS-12 showed molecular ion peak at 444 (M^+–1, 2.04%).

2.4. Surface Tension Measurements:

Surface tension measurements were done at 25°C ± 0.2 using a Due Nouy platinum ring method with Kruss K7 tensiometer. The values which remained constant for a period of 30 min. were taken as the surface tension of the solution. The critical micelle concentration (cmc) and the surface tension at the cmc were determined as the values of the break point of surface tension vs. concentration plots.

2.5. Biocidal Activity:

Biocidal activity of the synthesized schiff base surfactants was measured at the fermentation biotechnology and applied microbiology center (FBAM, Al-Azhar University) using inhibition zone technique in dimethyl formamide as a solvent. The studied microorganisms were identified for each strain as gram negative bacteria: *pseudomonas fluorescen (597), pseudomonas phaseolicola (GSPB 2828)*, gram positive bacteria: *Staphylococcus aurens* (ATCC 25923), *Staphylococcus pyogenes (*ATCC 19615) and fungi: *Fusarium oxysporum* and *Aspergillus fumigatus.*The antibiotic chloramphenicol was used as standard references broad antibiotic, cephalothin and cycloheximide were used as standard gram negative bacteria and antifungal references respectively.

2.6. Antitumor Activity:

The antitumor activity for the compounds under investigation was carried out at pharmacology unit, National Center Institute, Cairo, University.

The choice of Elhrlich ascites carcinoma (EAC) as a model system of mice cell tumor and it is a suitable tool for studying the biological behavior of malignant tumor and drug action within cells (Homburger 1981).

3. Results and Discussion:

3.1. The Surface Properties:

Fig. (1) Represents the variation for the surface tension vs. log. concentration of the synthesized schiff base amphiphiles at 25°C. The profile showed sharp break points corresponding to the critical micelle concentration values of the different surfactants. The critical micelle concentration (cmc) values of the synthesized amphiphiles are gradually decreased by increasing the length of the alkyl chains attached to the synthesized molecules (Table 2) which referred to increase of the hydrophobicity as a result of increasing the methylene groups (Oda *et al.*1997, Nagarajan, and Ruckern 2000). On the other hand, the hydrophilic substituent's have a considerable role in their cmc values. Derivatives which contain sulfonate groups (SBS) have a higher depression in cmc values than those containing carboxylate groups (SBA, SBC).

From surface tension lowering ability γ_{cmc} in Table 2, it can be seen that γ_{cmc} of schiff base amphiphiles increases with increasing hydrophobic chain length. This explained the increases of hydrophobicity of surfactants and compounds with dodecyl group in the alkyl chain for all series that showed the maximum surface tension lowering ability.

Table 2: Surface Properties of the Synthesized Schiff Base Amphiphiles at 25°C:

Compound	cmc x 10^{-3} mol/l	γ_{cmc} mN\m	π_{cmc} mN\m	PC_{20}	cmc/C_{20}	$\Gamma_{max.}$ Mol/cm^2	A_{min} x 10^2 nm^2	$-\Delta G_{mic}$ KJ/mol	$-\Delta G_{mic}/CH_2$	$-\Delta G_{ads}$ KJ/mol	$-\Delta G_{ads}/CH_2$
SBA-12	7.88	30.5	41.5	2.91	6.41	1.25	132.8	12.01		12.34	
SBA-16	7.41	34.0	38.0	2.99	6.62	1.42	116.9	12.16	0.19	12.43	0.17
SBA-18	5.62	36.0	36.0	3.32	9.32	1.60	103.8	12.84		13.07	
SBC-12	6.92	27.5	44.5	2.85	4.91	1.13	147.5	12.33		12.73	
SBC-16	5.50	30.0	42.0	2.95	4.92	1.14	143.6	12.89	0.17	13.25	0.16
SBC-18	4.68	31.5	40.5	3.05	5. 25	1.17	141.3	13.29		13.64	
SBS-12	6.61	37.5	34.5	2.83	4.47	1.20	138.3	12.44		12.73	
SBS-16	5.25	39.0	33.0	3.05	5.89	1.38	120.3	13.01	0.15	13.25	0.13
SBS-18	4.65	40.0	32.0	3.15	6.56	1.52	109.2	13.31		13.52	

Effectiveness (π_{cmc}) of the synthesized surfactants is the difference between the surface tension of distilled water and that at the cmc values, while the efficiency (PC_{20}) is the negative logarithm of surfactant concentration, which provides a 20 mN/m reduction in surface tension.

The effectiveness (π_{cmc}) values showed gradual decrease by increasing the hydrophobic chain length indicating the increasing of accumulated surfactant molecules at the interface. The maximum accumulation was indicated by the lowest surface tension depression at the critical micelle concentration and was recorded for SBC-12 at 44.5 mN/m. The efficiency values (PC_{20}) of the targeted surfactants (Table 2) showed their good tendency to modify the surface activity of their solutions at considerably low concentrations. Increasing the hydrophobic chain length of the studied amphiphiles results a decrease in the surface tension of the surfactant solution indicating the high tendency of the longer hydrophobic molecules to adsorb at the interface. The lowest PC_{20} value was observed to SBS-12.

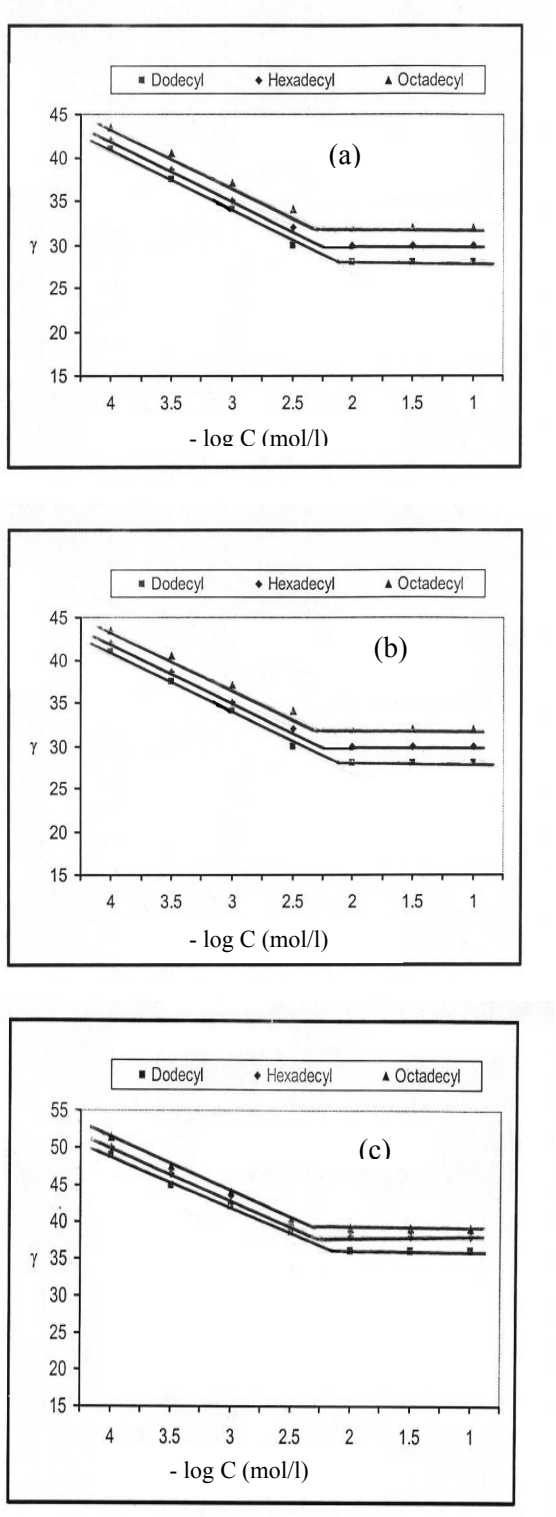


Fig .1 : Variation of Surface Tension (γ) against Concentration of the Synthesized Schiff Base Amphiphiles at 25°C (a) SBA , (b) SBC and (c) SBS

The cmc/C_{20} ratio is an index of adsorption onto the water/air interface relative to micellization in the bulk surfactant concentration. The cmc/C_{20} ratios of schiff base amphiphiles were listed in Table 2. It is obvious that the cmc/C_{20} ratios increase with the increase of hydrophobic alkyl chain length. This result suggests that SB with long hydrocarbon chains adsorb at the air/water interface in preference to forming micelles, whereas SB with short hydrocarbon chains do not adsorb efficiently at the interface.

It can be also found that the cmc/C_{20} values of schiff bases SBA are higher than those of SBC and SBS; the difference of the hydrophobic benzene ring may be the main reason.

Values of the minimum surface areas occupied by schiff base amphiphiles at the interface (A_{min}) were calculated according to the equation:

$$A_{min} = \frac{10^{16}}{N\Gamma_{max}}$$

Where Γ_{max} and N are the maximum surface excess and Avogadro's number respectively.

Increasing the maximum surface excess values indicates the increasing of adsorbed molecules at the interface, hence the area available for each molecule will decrease .That causes the compacting of surfactant molecules at the interface to form denser layer.

From Table 2, it can be seen that A_{min} values of SBC and SBS are larger than those of SBA and A_{min} is greatly influenced by the hydrophobic alkyl chain length. Increasing the hydrophobic alkyl chain length increases A_{min} values at the interface. It is well known that phenyl is a rigid group, so the hydrophobic groups of SBC and SBS pack rather loosely than those of SBA. Also, increasing the maximum surface excess (the accumulation of surfactant molecules at the air/water interface, Γ_{max}) indicates the surfactant/water repulsion in the bulk of the solution which pumps the surfactant to the air/water interface. Longer hydrophobic alkyl chain lengths showed longer Γ_{max} values and derivatives which contain phenyl ring have a lower Γ_{max}; SBC, SBS than those of SBA. That can be referred to the change of the hydrophobicity of the molecules under consideration by the type of substituents.

The thermodynamic characteristics of the synthesized anionic schiff base amphiphiles were studied using the calculated values of adsorption and micellization free energies ΔG_{ads}, ΔG_{mic}. These data were calculated using the thermodynamic equations (Azzam et *al.*2004) Table 2. The free energy changes of micellization and adsorption showed negative sign indicating the spontaneously of the two processes at

25°C. Also, $\Delta G_{mic.}$and ΔG_{ads} decreased slightly by increasing the hydrophobic chain lengths.

The maximum depression in ΔG_{mic} and ΔG_{ads} was observed for SBS-18 derivative at -13.31and -13.52KJ/mole, respectively.

The calculated increment $\Delta G_{mic}/CH_2$ and $\Delta G_{ads}/CH_2$ i.e., the change in ΔG_{mic} and ΔG_{ads} per one methylene group in alkyl substituted R was 0.15 and 0.13 KJ/mol which was lower indicates that the tendency of adsorption of SBS molecules from the bulk to the air/water interface is stronger than those of SBA and SBC molecules.

3.2. Evaluation of the Synthesized Surfactants as Antibacterial and Antifungal Agents:

Frequently, for numerous applications, it is highly desirable to develop the so-called functional surfactants, i.e., surface active compounds which show evidence of additional benefits. In this context the antimicrobial properties of surface active compounds are highly for applications in the cosmetic field, in consumer products, in cleaning liquids for medical instruments, as well as for the stabilization of industrial emulsions against deterioration by bacteria and fungi (Marcelo *et al*.2008 and Viscardi *et al*.2000)

Hence, the above synthesized schiff base surfactants were tested regarding their activities against a series of bacteria (Gram positive: *Staphylococcus aureus* ATTC 25923, *Staphylococcus pyogenes* ATCC 19315; Gram negative: *Pseudomonas fluorescen* S97, *Pseudomonas phaseolicola* GSPB 2828 and fungi: *Fusarium oxysparum, Aspergillus fumigatus.* The data of biological activity of the reported compounds at 1 and 2 mg/ml are given in Table (3 & 4). The results showed that our surfactants are in general capable of inhibiting the growth of bacteria and fungi to a moderate extent. Also, it is clear from Tables 3, 4 that the biological activities of the synthesized surfactants against the tested microorganism increase by increasing their doses. The highest activity was observed at 2 mg/ml. On the other hand, the most effective factor is the carbon chain length; it was found that, as the carbon chain length (hydrophobic part) increases, the compound efficiency also increases. That can be related to their ability of adsorption at the interface. Increasing the absorbability increases their action on the cell membrane. The absorption of schiff base molecules on the cell membrane decreases its permeability which disturbs the biological process in these cells leading to their death. So, C_{16} and C_{18} derivatives showed a higher effective biocidal action upon tested bacteria and fungi. Also, the presence of benzene ring slightly decreases its effect.

Table 3: Antimicrobial Activity of the Synthesized of the Schiff Base Amphiphiles:

Compound	Mean of zone diameter (mm)/different conc.							
	Gram-positive				Gram-negative			
	***Staphylococcus* aureusATCC 25923**		***Staphylococcus pyogenes* ATCC 19315**		***Pseudomonas fluorescen*(597)**		***Pseudomonas phascolicala* (GS PB 2828)**	
	2	**1**	**2**	**1**	**2**	**1**	**2**	**1**
SBA-12	-	-	-	-	18	14	17	10
SBA-16	5	3	7	2	22	19	23	18
SBA-18	10	7	12	6	26	22	24	19
SBC-12	-	-	-	-	12	9	12	8
SBC-16	-	-	-	-	13	9	14	8
SBC-18	12	8	10	7	19	10	17	9
SBS-12	-	-	-	-	10	7	8	5
SBS-16	-	-	-	-	12	8	12	8
SBS-18	-	-	-	-	17	13	20	16
Control	42	28	38	30	36	36	25	30

Chloromphenical as broad antibiotic and cephalothin as reference for gram negative.

Table 4: Antifungal Activity of the Synthesized Schiff Base Amphiphiles:

Compound	Mean of zone diameter (mm)/different conc.			
	Fusarium oxysporum		*Aspergillus fumigatus*	
	2	**1**	**2**	**1**
SBA-12	10	8	12	9
SBA-16	16	12	14	10
SBA-18	18	13	16	11
SBC-12	4	2	6	2
SBC-16	10	3	12	10
SBC-18	13	8	12	11
SBS-12	4	2	6	2
SBS-16	6	4	7	4
SBS-18	12	8	12	10
Control	40	28	40	30

Cycloheximide is used as reference for fungi

3.3. Antitumor Activity:

In vitro, anticancer cytotoxin activity of synthesized schiff base amphiphiles was investigated using EAC at different concentrations (25, 50 and 100%); Table 5. The tumouricidal effects of the compounds under investigation were tested on the survival of cultured EAC cells, the antitumor activity of the targeted compounds was expressed as a percentage of non viable cells (% NVC) calculated as follows:

$$NVC\% = \frac{\text{number of NVC}}{\text{Total number of cells}} \text{ X } 100$$

From Table 5, it is clear that the cytotoxic effects of these compounds were dose dependent, i.e. by increasing the concentration on these compounds in the culture media; the percentage of non-viable cells (EAC) is increased. Also from data of Table 5 one observes that upon testing the schiff base compounds which contains more than one benzene ring, the antitumor activity dramatically increases from 0% of non-viable EAC cells at 25 mg/ml to 95% of these cells at 100 mg/ml and also NVC% increases by increasing the chain length of the hydrophobic radical.

To achieve the maximum therapeutic damage of tumor cells using the minimum concentration of drugs, the tumor cells lines used in this study for SBA-12 which causes the death of 95% of EAC cell are liver carcinoma ($HEPG_2$), breast carcinoma (MCF 7) and colon carcinoma (HCT 116); Table 6 and Fig. 2.The 50% growth inhibitory concentration (IC_{50}) values for SBC-12 at different concentration ranged from 1 to 10 mg/ml is recorded. Data showed that SBC-12 was found to exhibit high activity in vitro system on the tumor cell lines investigated and the highest cytotoxic effect on FEPG2, HCT116 and MCF7, respectively.

Finally, in our research, we found that SBC-12 surfactant affects tumor tissue at very low concentrations at values lower than their cmc values which means that there is a strong relationship between very small values of cmc of this compound and its ability to reach IC_{50} values under very low concentration. This is due to the fact that increasing the concentration of schiff base surfactants causes an increase in the adsorption process on cells membranes till the cmc is reached; after this adsorption slowly decreases and then stops due to the formation of micelles, which prevent mobility and suppresses antitumor activity.

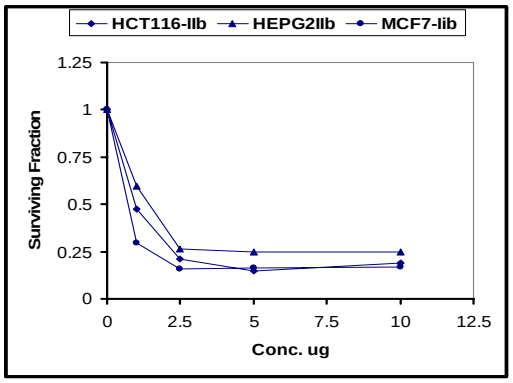


Fig .2 : Surviving Reaction of HCT116 , HEPG 2 and MCF7 against Concentration of 2-Alkoxy (benzylidine imine) Benzene-1-Carboxylic Acid; SBC-12

Table 5: Antitumor Activity of the Synthesized Schiff Base Amphiphiles Using Eltirlich Ascites Carcinoma (EAC).

Compound	Inhibition percent of cell viability (mg/ml)/conc.		
	25%	50%	100%
SBA-12	0	0	0
SBA-16	0	0	10
SBA-18	0	0	20
SBC-12	20	60	95
SBC-16	20	40	80
SBC-18	20	40	80
SBS-12	0	0	20
SBS-16	0	20	40
SBS-18	10	30	70

Table 6: Cytotoxicity Activity of 2 - Dodecyloxy (benzylidine Imine) Benzene Carboxylic acid (SBC-12) Using Colon Carcinoma (HTC 116), Liver Carcinoma (HEPG2) and Breast Carcinoma: (MCF7) as Tumor Cell.

Conc.	HCT116	HEPG-2	MCF7
0.0	1.00000	1.000000	1.000000
1.0	0.47640	0.59383	0.2963272
2.5	0.20971	0.264045	0.156162
5.0	0.14832	0.245392	0.162409
10.6	0.18761	0.245392	0.167718

4. Conclusion:

A series of anionic surfactants containing schiff base group have been synthesized and their chemical structures were confirmed using elemental analyses, FTIR, ^{1}H-NMR, and mass spectroscopy. Their surface activities were determined based on the data of surface tension. It was found that critical micelle concentration (cmc) values of these amphiphiles were gradually decreased by increasing the length of the alkyl chains attached to the synthesized molecules which referred to increase the hydrophobicity as the result of increasing the methylene groups. Thermodynamics of adsorption and micellization processes of these surfactants in their solutions were also calculated. Results were indicated that these compounds have tendency towards adsorption at the interface and also micelle formation at lower concentrations. Biocidal activity of prepared amphiphiles was investigated against bacterial and fungi species which showed that our surfactants are in general capable of inhibiting the growth of bacteria and fungi to a moderate extent. Also, it is clear that the biological activities of the synthesized surfactants against the tested microorganism increase by increasing their doses. Antitumor activity of these surfactants was evaluated against three human tumor cells such as $HEPG_2$ (liver), HCF_7 (breast) and HCT116 (colon). The cytotoxic effects of these compounds were dose dependent, i.e. by increasing the concentration on these compounds in the culture media; the percentage of non-viable cells (EAC) was increased. Also, data showed that SBC-12 was found to exhibit high activity in vitro system on the tumor cell lines investigated and the highest cytotoxic effect on FEPG2, HCT116 and MCF7, respectively

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