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Screening The Anticancer Activity for New Schiff Bases of Natural Steroids

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ABSTRACT. The significance of cholesterol and ergosterol (provit. D2) in biological systems has prompted interest in these compounds as pharmaceuticals. It has been reported on the effective straightforward synthesis of Schiff base modifications of cholesterol aldehyde and ergosterol aldehyde and their assessment as possible agents against cancer (cancer cell lines and natural cell lines). Through a process called Steglish esterification, the initial cholesterol and ergosterol were converted into their respective aldehyde derivatives, by reacting with amines such as 2-amino 6-fluoro benzothiazole, carbohydrazide, and thiosemicarbazide, these aldehyde derivatives were transformed into the appropriate Schiff base derivatives, and then their anticancer activity was checked using the MTT (Microculture Tetrazolium Assay) method. To analyze thier cytotoxic effects, these compounds were tested on cancerous (SK-GT-4, human esophageal adenocarcinoma) and normal (normal cell line, Rat Embryonic fibroblast (REF)) cell lines. The MTT assay results revealed that the compounds (a1, a2, c1, c2, compound 1) were more harmful to human esophageal cancer cell lines than to healthy cell lines other than compounds (t1, t2, compound 2, ergosterol, and cholesterol). Overall, our research indicated that provitamin D2 (ergosterol), a1, a2, c2, t2 and compound 1, showed a growth-inhibiting effect on both cell lines compared to c1, t1, compound 2, and cholesterol.

Keywords: Antitumor activity, steroidal derivatives; cholesterol; ergosterol; MTT assay

INTRODUCTION

In recent years, there has been a lot of academic interest in the rational altering of steroid molecules. This is most likely the case given the many benefits linked to steroid-based chemotherapeutics. Because of their ability to permeate the cell wall, these compounds seem to be non-toxic, less likely to produce multi-drug resistance (MDR), and highly bioavailable (Cheng et al., 2019; Mollaei et al., 2021; Tian et al., 2017). This is especially true for modified steroids that have structural components called heterocyclic systems. These systems have proven to have a variety of biological effects, such as diuretic, anti-microbial, anti-inflammatory, hypotensive, and cholesterol-lowering effects (Aj et al., 1963; Gupta et al., 1996; Hirschmann et al., 1963, 1964; Wang et al., 1993). This has led to the addition of additional heterocyclic systems or functional groups to the basic structure of steroids. In general, Schiff bases have been documented to have antioxidant and anti-inflammatory properties (Kajal et al., 2013; Shah et al., 2020). As an illustration, a study planned and created four Schiff base derivatives with the goal of creating a lead chemical that has anti-inflammatory properties and avoids the negative consequences of NSAIDs (non-steroidal anti-inflammatory drugs), particularly GI toxicity (Hamid et al., 2022). In another work, quinazolinone derivative Schiff bases were produced and their in vitro antioxidant activities were assessed; it was discovered that their activities were comparable to those of commercial antioxidants (Rakesh et al., 2015). Schiff base of sulphanilamide has been developed, by combining 4-Hydroxy-3-methoxybenzaldehyde (vanillin) and 4-aminobenzene-1-sulfonamide (sulphanilamide medicine), an excellent yielding derivative of Schiff base was produced that was less hazardous than the sulphanilamide drug itself (Al-Halfi et al., 2020). However, researchers from the University of Basrah improved the QSAR (quantitative structure-activity relationship) investigation of certain Schiff-base ligands as prostate cancer anticancer agents (Hussain et al., 2012) A wide range of biological properties, such as analgesic, antibacterial, anticonvulsant, antitubercular, anticancer, and others, are also present in Schiff bases (Kajal et al., 2013). According to recent investigations, steroidal derivatives may be effective anticancer medications

(Brito et al., 2021; Ke et al., 2013; Li et al., 2022; Song et al., 2019; Tantawy et al., 2017).

This study examined the synthesis of Schiff base steroidal derivatives from natural ergosterol (fungal and protozoal origin) and cholesterol (animal origin). However, numerous research on the synthesis of Schiff base derivatives from various starting materials have been conducted (Asiri et al., 2010; Azad et al., 2023; Fonkui et al., 2019; Hamid et al., 2022; Rakesh et al., 2015; Shailesh et al., 2022). Despite a few early papers on the synthesis of steroidal derivatives, no literature examples were located that described the synthesis of steroidal Schiff base derivatives using the methodology we used. Taking into account all of these facts, we present in this article a simple method for producing steroidal Schiff base derivatives starting from cholesterol and ergosterol, utilizing the intermediary of the corresponding aldehyde derivatives prepared through condensation with 4-carboxy benzaldehyde, respectively.

EXPERIMENTAL SECTION

General

The spectrum of several compounds is shown below; the majority of the peaks caused by the steroidal skeleton were combined and could not be distinguished. Only the peak values that clearly differentiate the product and might be separated were presented as a result.

The synthesized compounds were first purified by silica column gravity chromatography using appropriate solvents with eluent ratio (10-50% ethyl acetate in chloroform). The FT-IR from Bruker Tensor 27, made in Japan spectrophotometer was used to run the IR spectra at the College of Education for Pure Sciences of Thi Qar University. The Chemistry Department of the College of Education for Pure Sciences at the University of Basrah was analyzing nuclear magnetic resonance spectra. ^{1}H NMR was recorded on a NEO 400 (400 MHz) Bruker Avance spectrometer making use of residual solvent in all cases in deuterated chloroform using TMS as an internal standard. Chemical shift (δ) is given in ppm. The mass spectra at Samarah University were captured by the use of a Shimadzu GCMS-QP2010 plus model. TLC-precoated 60 F254 silica gel plates with a 0.25 mm thickness were used to track all reactions' progress (Merck). Under UV 254–366 nm, the chromatogram was seen.

Chemical Synthesis

Synthesis of compound 1

In a round-bottomed flask, cholesterol (3.0 gm, 7.759 mmol), 4-carboxy benzaldehyde (7.759 mmol, 1.20 gm), 4-dimethylamino pyridine (DMAP) (0.240 gm, 1.939 mmol), and dicyclohexylmethanediimine (DCC) (1.610 gm, 7.760 mmol) were added then the round was evacuated, and dry dichloromethane (DCM) 30 mL was added. The reaction was stirred at 0° C for seven hours. Thin layer chromatography was used to check the reaction (5% methanol in DCM (dry dichloromethane)). Once the reaction was finished, 50 mL of DCM (dry dichloromethane) was added to the reaction product. Through a Buchner funnel, the product was filtered. An additional 50 mL of DCM was added and the product was filtered again. At room temperature, the compound was allowed to evaporate. It was chromatographed on silica gel in 5% ethyl acetate in chloroform to produce crystals of cholesterol aldehyde (**Figure 1**), which were light white crystals (3.80 gm pure product, 69%, 7.375 mmol). TLC R_f = 0.87 (5% methanol in DCM).^{1}H NMR (400 MHz, $CDCl_3$) δ 10.1 (s, 1H), 8.2 (d, 2H), 7.9 (d, 2H), 5.4 (t, 1H), 4.9 (m, 1H), ppm. (KBr disk, cm $^{-1}$) IR: 3010.44 (aromatic C–H), 1711 (aromatic C=O), 2862-2948 (aliphatic or cyclic or aldehyde C–H, M^+ ion peak (519).

Synthesis of compound (t1)

Thiosemicarbazide (0.035 gm, 0.385 mmol) was completely dissolved after being solubilized in 5 mL of methanol in a round-bottomed flask for 15 minutes in a thermal circulator. Cholesterol aldehyde derivative (Compound 1), (0.20 gm, 0,385 mmol) was subsequently added to the flask with 3 mL of chloroform, then heat was applied to the mixture under reflux at 100 °C while being stirred for 5 hours. TLC was used to check the reaction (10% ethyl acetate in DCM). It was chromatographed on silica gel with 20% ethyl acetate in DCM to produce compound t1 (**Figure 2**) as crystals of light-yellow color (0.10 gm pure product, 50%, 0.169 mmol).

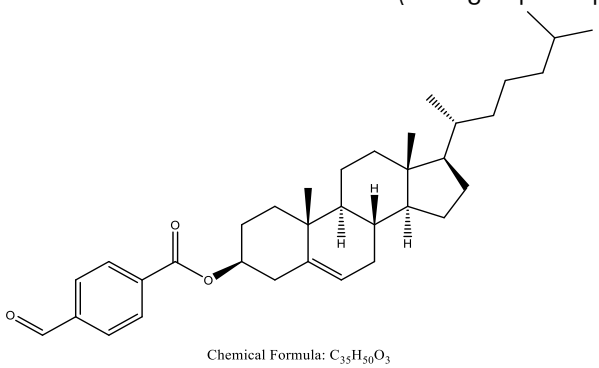
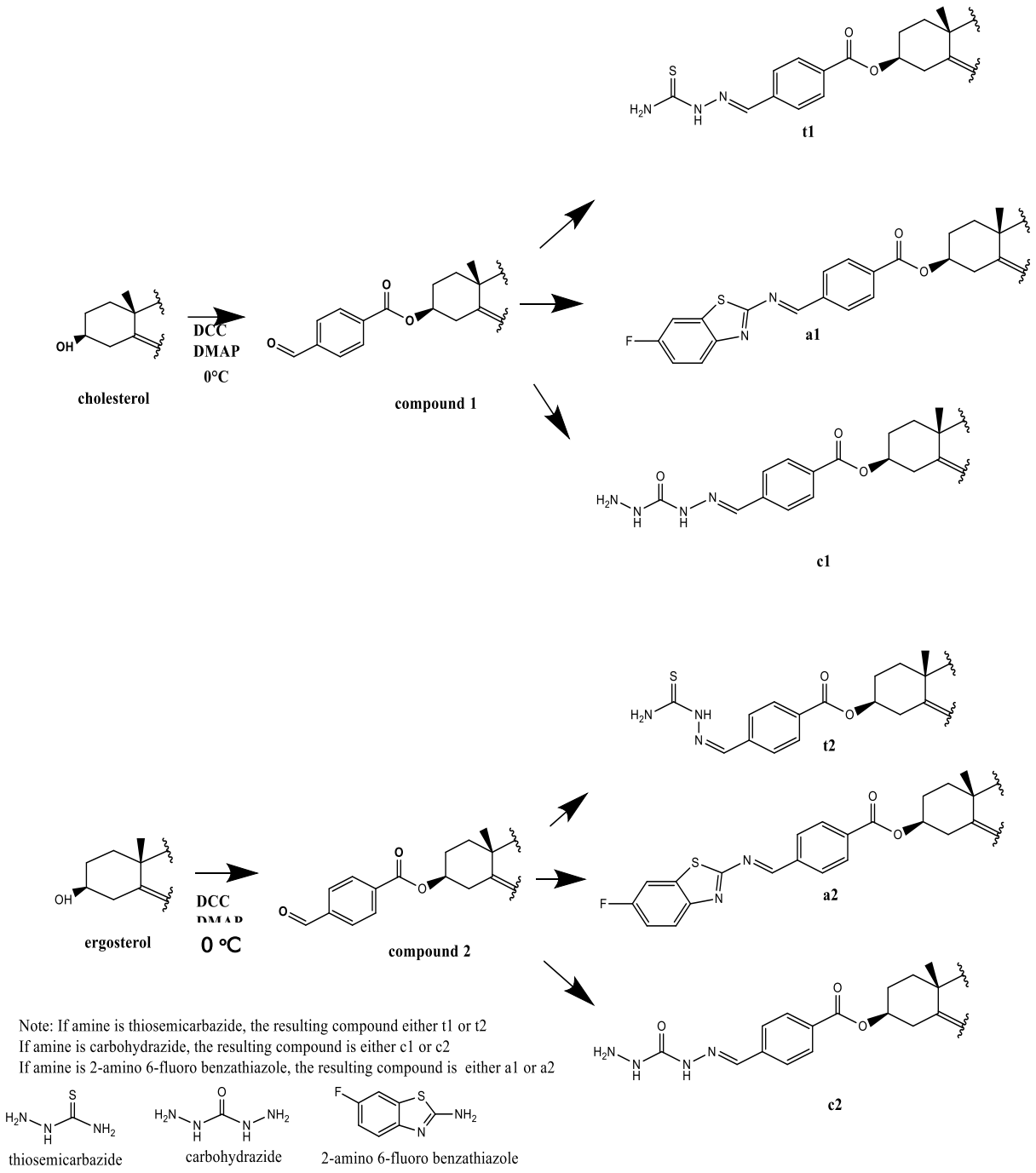


Figure 1. Structure of compound 1



Scheme: Pathways for synthesized Schiff bases

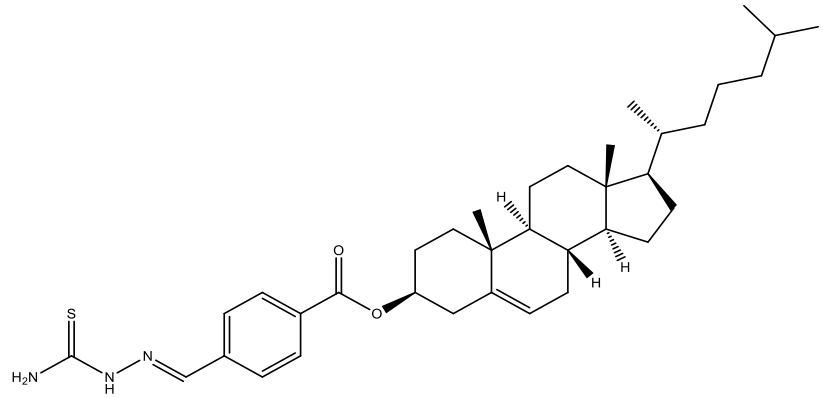
TLC R_f = 0.62 (10% ethyl acetate in DCM). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.8 (s, 1H), 7.9 (s, 1H), 8.1 (d, 2H), 7.7 (d, 2H), 6.5 (s, 1H), 5.5 (d, 1H), 4.8 (m, 1H) ppm. IR (KBr disk, cm^{-1}): 3430 (secondary N-H), 3146, 3235 (primary NH_2), 1651 (C=N), 1696 (C=O), 2849-2935 (aliphatic or cyclic C–H), 3047 (aromatic C–H), M^+ ion peak (591).

Synthesis of compound (a1)

In a round-bottomed flask, 2-amino 6-fluoro benzothiazole (0.130 gm, 0.770 mmol) was completely dissolved in 3 mL of methanol under reflux in a heat circulator for 15 minutes. Cholesterol aldehyde derivative (compound 1), (0.40 gm, 0.385 mmol) was added to the flask with 3 mL of chloroform, and the mixture was heated under reflux at 100°C while stirring for 5 hours. TLC was used to monitor the reaction (10% ethyl acetate in chloroform). The product passed 10% (ethyl acetate in DCM) silica gel chromatography to produce compound a1 (**Figure 3**) as light-yellow crystals (0.025 gm pure product, 5%, 0.037 mmol). TLC R_f = 0.5 (10% ethyl acetate in chloroform). ^{1}H NMR (400 MHz and $CDCl_3$) δ 9.1 (s, 1H), 8.21 (d, 2H), 8.1 (d, 1H), 7.9 (d, 1H), 7.5 (d, 1H), 7.1 (t, 1H), 5.5 (t, 1H), 4.9 (m, 1H) ppm. IR (KBr disk, cm^{-1}): 1706 (C=O), 1641 (C=N), 3093 (aromatic C-H), 2859-2933 (cyclic or aliphatic C-H), M^+ ion peak (668).

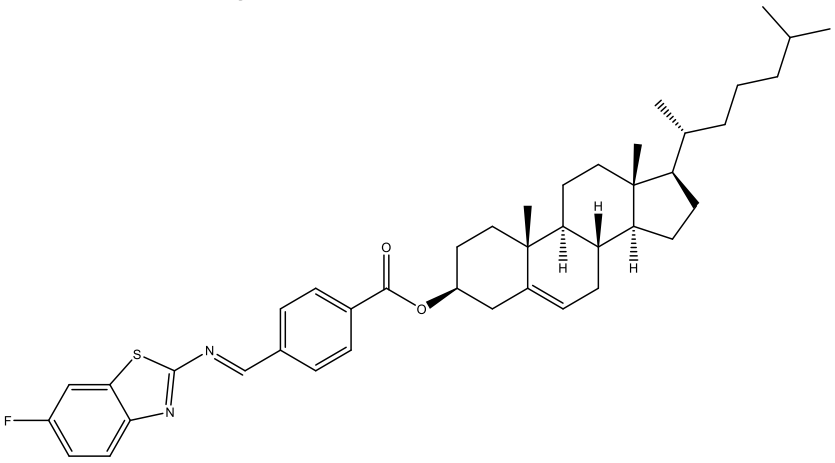
Synthesis of compound (c1)

Carbohydrazide (0.112 gm, 1.230 mmol) was completely dissolved in 5 mL of methanol after 15 minutes of heat circulation in a round-bottomed flask under reflux. Cholesterol aldehyde derivative (compound 1), (0.641 gm, 1.230 mmol), was added to the flask with 3 mL of chloroform and the mixture was heated under reflux at 100°C while being stirred for 5 hours. TLC was used to monitor the reaction (10% ethyl acetate in chloroform). It was chromatographed on silica gel in a mixture of 10% ethyl acetate in DCM to produce of compound c1 (**Figure 4**) as crystals of a light-yellow color (0.056 gm pure product, 8%, 0.095 mmol). TLC R_f = 0.5 (10% ethyl acetate in chloroform). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.7 (s, 1H), 8.3 (s, 1H), 8.2 (d, 2H), 8 (d, 2H), 5.5 (t, 1H), 5.3 (m, 1H), 4.9 (s, 2H) ppm. IR (KBr disk, cm^{-1}): 1714 (C=O), 1653 (C=N), 2851-2942 (cyclic or aliphatic C–H) M^+ ion peak (591).



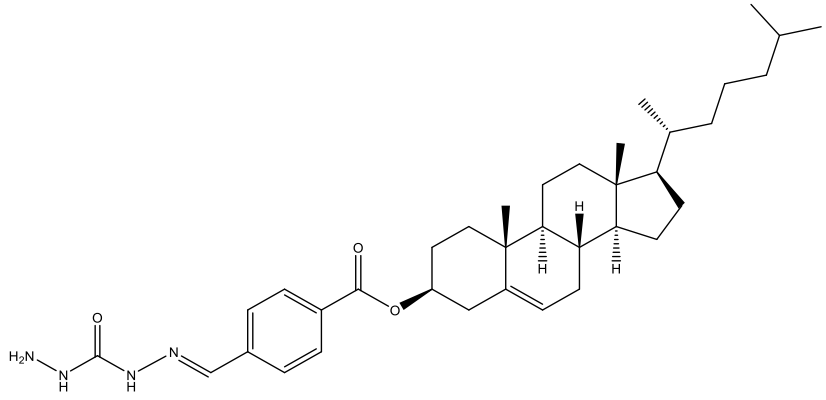
Chemical Formula: $C_{36}H_{53}N_3O_2S$
Molecular Weight: 591.90

Figure 2. Structure of compound t1



Chemical Formula: $C_{42}H_{53}FN_2O_2S$
Molecular Weight: 668.96

Figure 3. Structure of compound a1



Chemical Formula: $C_{36}H_{54}N_4O_3$
Molecular Weight: 590.85

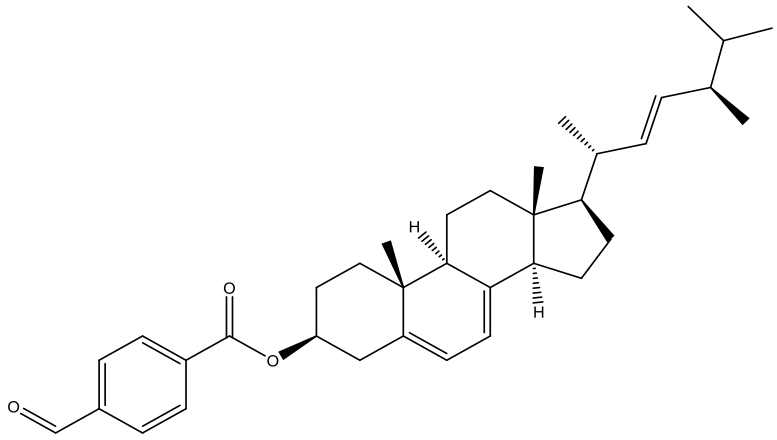
Figure 4. Structure of compound c1

Synthesis compound 2

Ergosterol (3.0 gm, 7.563 mmol), 4-carboxy benzaldehyde (1.135 gm, 7.563 mmol), 4-dimethylamino pyridine (DMAP) (0.231 gm, 1.891 mmol), and dicyclohexylmethanediimine (DCC) (1.560 gm, 7.563 mmol) were placed in a round-bottomed flask then the round was evacuated, and 30 mL of dry dichloromethane was added. For 7 hours, the reaction was agitated at 0 °C. TLC was used to monitor the reaction (5% ethyl acetate in DCM). 50 mL DCM was added to the reaction product once the reaction was finished. Through a Buchner funnel, the product was filtered. The product was filtered again after a further 50 mL of DCM was added. At room temperature, the compound was allowed to evaporate. It was chromatographed on silica gel in 10% ethyl acetate in DCM to obtain ergosterol (provit. D2) aldehyde as light brown crystals, (0.825 g, 15%, 1.56 mmol) (**Figure 5**). TLC R_f = 0.9 (10% methanol in DCM). ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.1 (s, 1H), 8.3 (d, 2H), 8.2 (d, 2H), 8 (d, 2H), 5.4 (s, 2H), 5.2 (d, 2H), 4 (m, 1H) ppm. IR (KBr disk, cm^{-1}): 1710 (aldehydic C=O), 2729 (aldehydic C–H), 2872-2959 (cyclic or aliphatic C–H), M^+ ion peak (528).

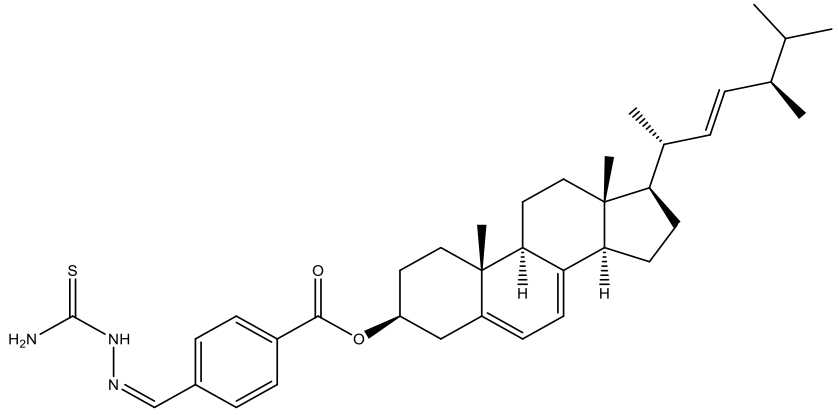
Synthesis compound (t2)

Thiosemicarbazide (0.052 gm, 0.567 mmol) was dissolved in 3 mL of methanol in a round-bottomed flask and then subjected to reflux in a thermal circulator for 30 minutes to complete its solubility. Ergosterol aldehyde derivative (compound 2) (0.30 gm, 0,567 mmol) was subsequently added to the flask with 3 mL of chloroform and heat was applied to the mixture under reflux at 100 °C while being stirred for 5 hours. TLC was used to monitor the response (10% ethyl acetate in chloroform). The crude compound was chromatographed on silica gel with 10% ethyl acetate in DCM to obtain dark-brown crystals (0.050 gm pure product of compound t2, 18%, 0.083 mmol (**Figure 6**)). TLC R_f = 0.75 (10% ethyl acetate in chloroform). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.5 (s, 1H), 8.11 (d, 2H), 7.9 (s, 1H), 7.7 (d, 2H), 6.5 (s, 1H), 5.3 (d, 2H), 5.2 (d, 2H), 4 (m, 1H) ppm. IR (KBr disk, cm^{-1}): 3420 (primary N-H), 3162-3263 (secondary N-H), 2869-2956 (cyclic or aliphatic C-H), 1698 (C=O), 1653 (C=N) M^+ ion peak (601).



Chemical Formula: $C_{36}H_{48}O_3$
Molecular Weight: 528.78

Figure 5. Structure of compound 2



Chemical Formula: $C_{37}H_{51}N_3O_2S$
Molecular Weight: 601.89

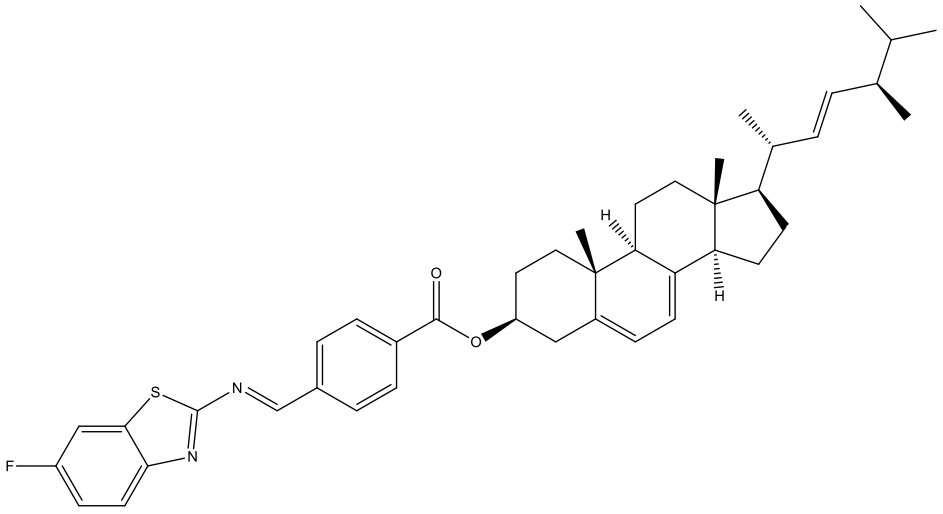
Figure 6. Structure of compound t2

Synthesis compound (a2)

2-Amino-6-fluorobenzothiazole (0.064 gm, 0.378 mmol) was dissolved in 3 mL of methanol in a round-bottomed flask while being subjected to a heat circulator for 15 minutes to ensure total solubility. 3 mL of chloroform and (0.20 gm, 0.378 mmol) of ergosterol aldehyde derivative (compound 2) was then added to the flask while being heated under reflux for 4 hours at 100°C while stirring. TLC was used to monitor the response (ethyl acetate in chloroform at 10%). Silica gel (containing 10% ethyl acetate in DCM) was used in chromatographic analysis to produce compound a2 (**Figure 7**) as crystals of light-yellow color (0.050 gm pure product, 20%, 0.076 mmol). TLC R_f = 0.375 (10% ethyl acetate with chloroform). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.1 (s, 1H), 7.7 (d, 1H), 7.5(t, 1H), 7.4 (t, 1H), 7.3 (d, 2H), 7.1 (d, 2H), 4.9 (d, 1H), 4.6 (s, 1H), 4.1 (m, 1H) ppm. IR (KBr disk, cm^{-1}): 2830-3000 (cyclic or aliphatic C-H), 1720 (C=O), 1629 (C=N), 3091 (aromatic C–H), 1573 (C=C), M^+ ion peak (678).

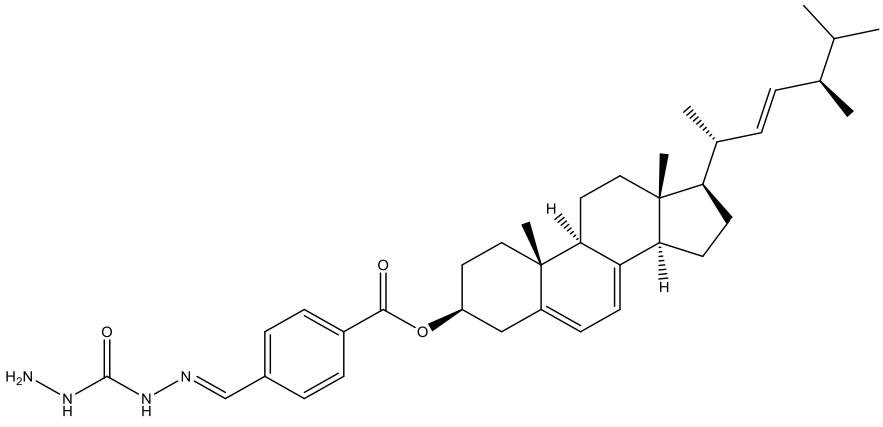
Synthesis of compound (c2)

Carbohydrazide (0.017 gm, 0.189 mmol) dissolved in 4 mL of methanol in a round-bottomed flask while being subjected to a thermal circulator for 15 minutes to ensure total solubility. 4 mL of chloroform and ergosterol aldehyde derivative (0.10 gm, 0.189 mmol) (compound 2) was then added to the flask. The mixture was heated under reflux at 100 °C while stirring for 5 hours. TLC was used to monitor the response (10% ethyl acetate in chloroform). The crude compound was chromatographed on silica gel with 10% ethyl acetate in DCM to yield compound c2 (**Figure 8**) as crystals of light-yellow color (0.024 gm pure product, 20%, 0.040 mmol). TLC R_f = 0.385 (10% ethyl acetate in chloroform). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.4 (s, 1H), 8.1 (s, 1H), 8.05 (d, 2H), 8 (d, 2H), 7.7 (s, 1H), 6.4 (d, 2H), 5.3 (m, 1H), 5.1 (s, 1H), 4.6 (d, 2H) ppm. IR (KBr disk, cm^{-1}): 1719 (C=O), 1615 (C=N), 2870-2958 (cyclic or aliphatic C–H), 3264 (primary NH_2), M^+ ion peak (601).



Chemical Formula: $C_{43}H_{51}FN_2O_2S$
Molecular Weight: 678.95

Figure 7. Structure of compound a2



Chemical Formula: $C_{37}H_{52}N_4O_3$
Molecular Weight: 600.85

Figure 8. Structure of compound c2

Biological Activity

Cell line: Cancer cell line vs normal cell line
Negative control: cell culture medium and positive control: DMSO

Materials and methods

Compounds and reagents: RPMI 1640 (Gibco USA), Trypsin/EDTA (Capricorn USA), DMF (Santa Cruz USA), MTT stain (Sigma USA), and Fetal bovine serum (Gibco USA).

Instruments; Micropipette (Cypress Diagnostics Belgium), Plates for cell culture (Thermo Fisher Scientific USA), Laminar flow hood (Laminar flow hood Korea), Microtiter reader (Thermo Fisher Scientific USA), CO_2 incubator (Cypress Diagnostics Belgium)

Methods

Maintenance of cell cultures

The IRAQ Biotech Cell Bank Unit in Basrah contributed the cancer cell lines, and they were kept in RPMI-1640 that had 100 units per milliliter of penicillin, 100 μg/mL of streptomycin, and 10% fetal bovine added to it. Using trypsin-EDTA, cells were passaged. Twice to three times a week, they were reseeded at 70% confluence, and they were incubated at 37 °C and 5% CO_2 (Al-Ali et al., 2022).

Cell toxicity tests

The MTT cell viability experiment was carried out on 96-well plates to determine the cytotoxic effect. The cell lines were seeded with 10^4 cells per well (Falih et al., 2022). After 24 hours or when a confluent monolayer was reached, cells were exposed to the test compounds at 1000 μg/mL for each compound. After 72 hours of treatment, the medium was taken out, 28 μL of a 2 mg/mL MTT solution was added, and the cells were then incubated for 2 hours at 37 °C, and cell viability was evaluated. After the MTT solution was withdrawn, the remaining crystals in the wells were solubilized by adding 100 μL of DMSO (dimethyl sulphoxide), which was then incubated at 37 °C for 15 min while being shaken (Al-Shammari et al., 2019). The assay was completed in triplicate, and the absorbency was determined at 620 nm using a microplate reader (the test wavelength). The proportion of cytotoxicity, or the rate at which cell growth was suppressed, was calculated as follows: The formula for the rate of proliferation is (PR)= B/A*100, where A is the average optical density of untreated wells, The average optical density of the treated wells is B, and IR is equal to 100 minus the proliferation rate (Freshney, 2010).

RESULTS AND DISCUSSION

Few efforts have been reported for the efficient synthesis of Schiff base-based derivatives at the A-ring (the first ring of the steroidal skeleton) of steroids, including the crucial subgroup known as sterols. A study, however, reported converting pregnenolone into a Schiff base using aniline with nitrogen-containing substituents in the D ring (the last ring of the steroidal skeleton) (Stulov et al., 2013). A second study reported the synthesis of steroidal derivatives containing substituted, fused, and spiropyrazolines of pharmaceutical interest (Romero-López et al., 2014). While there are no specific studies on Schiff base-based derivatives at the A-ring of steroids, the search results suggest that further research is necessary to develop efficient methods for synthesizing steroidal derivatives containing nitrogen-containing substituents, including Schiff base-based derivatives on the A ring of steroids. In continuation of our efforts to synthesize novel A-ring heterocycles, a new, quick, and effective method for creating cholesterol and ergosterol A-ring steroidal Schiff base derivatives was described, along with an analysis of their potential anticancer properties (**Scheme 1**).

Biological activity

The results on the percent of inhibition of cancer cells acquired after treating two cancer cell lines (normal and malignant) with test dosages (1000 μg) of several steroidal Schiff base derivatives are shown in the accompanying table and figure. The values are expressed as percentages.

The information provided in **Table 1** and **Figure 1** can be used to create a number of relationships. The percentage figures reveal that the compounds a1, a2, c2, t2, and compound **1** have a significant amount of cytotoxic action, particularly against the cancer cell lines SK-GT-4. Additionally, when only the hydroxyl group on the third position of cholesterol and ergosterol is substituted, the cytotoxicity of the compound increases by more than a few times for some cancer cell lines (cytotoxicity values of compounds a1, a2, c2, t2, and compound **1** can be compared for SK-GT-4 and REF cancer cell lines). The data also show that even the addition of double bonds to ring-B (ergosterol) and aliphatic chain after carbon 17 affects the relative toxicity. This can be ascribed to variances in their shape, which modifies the target protein binding qualities existing inside or on the cell membrane, or in their polarity, which influences their lipophilicity (for comparison see the values of c1, c2 and t1, t2 and also compound **1** and compound **2**). Compounds a1 and a2, which have a 2-amino 6-fluoro benzothiazole substituent on the A ring, demonstrated notable cytotoxicity with an SK-GT-4 cell line-specific toxicity (Gurupadayya et al., 2005; Kumbhare et al., 2014; Ravi et al., 2013, 2014). The metalloenzyme carbonic anhydrase (CA) was inhibited by the benzothiazole scaffolds, and a thorough literature review over the last 10 years revealed that benzothiazole derivatives mostly function as anticancer agents (Irfan et al., 2020). Compounds c2, which included a carbohydrazide substituent on the A ring, displayed notable cytotoxicity and was selective for the SK-GT-4 cell line, possibly with less toxicity to normal cells (REF cell line).

Table 1: Steroid Schiff base derivatives' percentages of growth suppression against a panel of cancer vs. normal cell lines, (mean ± SD).

Compound	% Inhibition on cancer Cells (SK-GT-4)	% Inhibition on normal Cells (REF)
a1	96.53 ± 0.48	89.24 ± 13
a2	98.23 ± 5.5	73.32 ± 12
c1	26.85 ± 11.5	17.21 ± 5.7
c2	96.26 ± 2.5	60.12 ± 15.3
t1	15.62 ± 6	42.26 ± 8.3
t2	90.65 ± 2	100.93 ± 1.85
compound 1	70.53 ± 18.6	28.78 ± 11.6
compound 2	18.78 ± 3.1	42.12 ± 9.4
D2	64.13 ± 2.6	132.49 ± 1
cholesterol	16.91 ± 8.25	24.61 ± 2.7

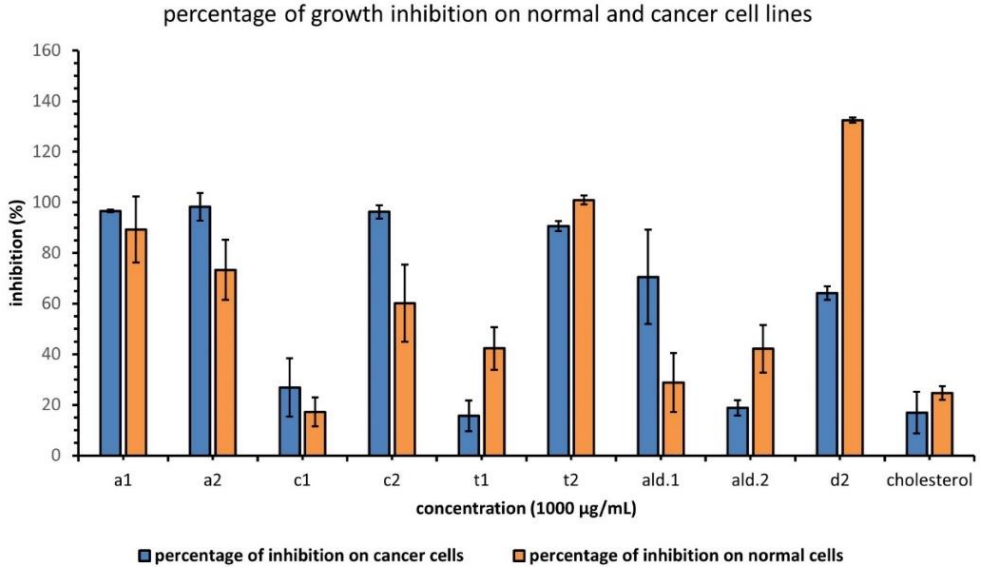


Figure 9: Cytotoxic activity of steroidal derivatives on both cell lines, (mean ± SD).

For their biological activities, derivatives of carbohydrazide have been investigated.

For instance, a brand-new class of dihydropyrazole–carbohydrazide compounds (DPCH) was created and studied for possible usage as human-use medications. These compounds displayed the ideal physicochemical and toxic biological characteristics for possible use as medicines for human use. The DPCH compounds demonstrated antioxidant activity comparable to ascorbic acid with an IC_{50} in the μM range and antiproliferative activity (Balbuena - Rebolledo et al., 2022). Additionally, ergosterol derivatives demonstrated much greater growth inhibition than their cholesterol derivative counterparts (see comparison of c2, t2 ergosterol derivatives against c1, t1 cholesterol derivatives). Supramolecular photosensitizers for enhanced antitumor photodynamic treatment were created using ergosterol peroxide, and they exhibit remarkable in vitro phototoxicity and in vivo enhanced anticancer efficacy (Cheng et al., 2019). In a different study, ergosterol peroxide probes were developed for cellular localization experiments, and it was found that ergosterol peroxide analogs have encouraging anti-proliferation effect against triple negative breast cancer cell types. This knowledge helped researchers develop more effective analogs by illuminating the structure-activity link of this natural substance (Ling et al., 2019).

CONCLUSIONS

Ergosterol and cholesterol were converted into novel steroidal Schiff base derivatives, and their anticancer properties were examined in a panel of two (cancer and normal) cell lines. The information revealed that all of the compounds exhibit favorable anticancer activity, with compounds a1, a2, and c2 being the most effective, particularly against the cancer cell line SK-GT-4, revealing the high degree of selectivity of the c2 molecule against the aforementioned cell line.

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