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FORMULATION AND EVALUATION OF UV RESISTANT PROPERTY OF THE HERBAL CREAM USING CRUCIFEROUS VEGETABLES LEAVES

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ABSTRACT

The demand for cosmeceuticals is rapidly expanding. The expansion is due to the availability of new ingredients, the financial rewards for developing successful products, consumer formulation needs maintenance of quality standards. the quality of a formulation should satisfy the consumer's need in terms of its performance. Herbal creams have several advantages over conventional chemical-based creams. Herbs and herbal preparations have a high potential due to their antioxidant activity, and anti-inflammatory activity primarily. The present study aims to prepare a UV resistant herbal cream containing the leaf extracts of brassicaceous vegetables (cauliflower, cabbage). The objective of this study was to develop sunscreen cream formulations with high sun protection factor (spf) and satisfied characteristics. This study focuses on uv protection from the sun and discusses potential herbal candidates with antioxidant properties that can serve as a strong barrier in cosmeceuticals to protect skin against harmful UV rays. GC-MS result provides the presence of various bioactive compounds and the identified 19 bioactive compounds such as N-hexadecanoic acid, dodecanoic acid, cyclohexanone, 4-H-Pyran-4-one, oleic acid etc. Mainly due to their antioxidant activity, these compounds have been suggested for potential use in cosmetics and the pharmaceutical industry, and this review aims to summarize current knowledge on the natural sources and biological activity of the substances.

1. Introduction

UV radiation is part of natural energy. It must be produced by the sun. On the electromagnetic spectrum, UV light the shorter wavelengths than visible light. There are 3 general types of UV rays. UVa, UVb and UVc. Each of these has a different wavelength. Two types of UV radiation are confirm to the risk for skin cancer (Amandine *et al*., 2019). Although UVc possesses the highest energy, it has the potential greatest for biological damage and are filtered effectively by the ozone layer. Therefore, it is not considered to be a factor in solar exposure of human beings and is not of biological relevance. Amount of UVA and UVB which reaching is affected by latitude, altitude, season, cloudiness, time of the day, and ozone layer on the earth's surface. The highest irradiance at the equator and of the higher altitudes. On the earth's surface, the ratio of UVB to UVA is 1: 20. The response to UVB irradiation on human skin leads to erythema, edema, and pigment darken continued by the thickening of the epidermis and dermis, delayed tanning and affects the synthesis of vitamin D.

The main cruciferous vegetable species is the *Brassica. Oleracea* (cabbage) which

includes vegetable type forms and forage forms such as kale, cabbage, broccoli, Brussels sprouts, cauliflower and others; Phenolic compounds have received considerable attention for being potentially protective factors against cancer and heart diseases, Flavonols are the most widespread of the flavonoids. Quercetin, kaempferol and isorhamnetin, these are main flavonols in *Brassica* crops. These are most found as O-glycosides. All these compounds are found in *Brassica* family. Flavonoids protect the plants against UV rays, which, to some extent, results from the fact that they can act as a screen absorbing, Besides UV absorption, flavonoid compounds may also transfer the photo energy to or from other molecules via sensitization. The role of flavonoids in response to UV radiation is mostly due to the scavenging of ROS generated during irradiation. It is reported that the ethanolic leaf extract of *Brassica oleracea* L. var capitata contains the highest amount of phenolic compounds and exhibited the greatest anti-oxidant activity, the various activities such as antioxidant, phenolic flavonoid content all leads in the factor of protection against UV rays.

Herbal extracts and oils have complex conformations, which results in the exposition of dissimilar effects, such as antioxidant, sun blocking, anti-inflammatory, and immunomodulatory. The efficacy of extracts in improving the skin advent and handling of various skin diseases is well understood. Plants due to their antioxidants likely are known as an attractive choice to be used in sunscreen designs for the prevention of skin impairment due to solar radiation. Because of the damaging effects of UV radiation, sunscreen formulations are developed to protect the skin against the harmful effects of UV radiation by either forming a protective barrier on the skin's surface or by absorbing the harmful rays. The UV filters mostly need oily base for their dissolution, so the sunscreen formulations commonly use oily base for solubilizing the UV filters. It was reported that oil-in-water or water- in-oil system were most common for sunscreen formulation. But the oily vehicle of emulsion system can leave the skin greasy which may not be suitable for acne prone skin. Emulgel, a formulation comprising emulsion incorporated in gel base can overcome earlier problem by making the formulation more water-based and less greasy (Anandan *et al*.,2018). Sunscreen it refers to the photoprotecting agent for UV protection. It is used to aid the tody's defense mechanisms to protect against harmful UV radiation from the sun. Hence after extraction of quercetin should be done to make an effective UV protection herbal cream. The sunscreen agents used currently in sunscreens for UV protection are not efficient against reactive oxygen species (ROS). Therefore, these formulations contain antioxidants to neutralize these ROS (Bhattacharya & Sherje,2020).

2. Materials and methods

2.1.Materials

30 gm of powder was extracted by Soxhlet apparatus with methanol (300ml). Extraction with different solvents like petroleum ether, ethyl acetate, methanol, distilled water was done using the soxhlet apparatus. Briefly, for every 300 mL of the each solvent, 30 g of the crushed plant leaves powder was used for soxhlet extraction. After extraction for 3 consecutive days, the crude liquids were evaporated. After evaporation extracts were preserved at 37°C. Then the extracts are dissolved in distilled water for phytochemical analysis (Ashish Aswal *et al*.,2013).

2.2 Extractive value determination

Extractive values are used for the determination of exhausted or adulterated drugs. The value of the crude drug limits the quality as well as the concentration of the drug. Thus, petroleum ether, ethyl acetate, methanol and water soluble extractive values were determined. The obtained extracts were concentrated to dryness by keeping filtrate for complete evaporation of solvent. The value in percentage was calculated by using the formula and recorded (Assunta Raiola et al.,2017).

Extractive value (%) = Weight of dried extract/ Weight of plant material X 100

(1)

2.3. Sun protection factor analysis

The in vitro sun protection factor was determined by the ultraviolet-visible spectrophotometry method described. Spectrophotometric readings were obtained for each extract (100 µg•mL−1) at 290–320 nm and SPF values were determined using Equation

$$SPF = CF \times \Sigma\ 290\ 320 \times EE(\lambda) \times I(\lambda) \times Abs(\lambda) \quad \textbf{(2)}$$

where SPF stands for sun protection factor: CF for correction factor; EE(λ) is the erythemogenic effect of wavelength radiation (λ) nm (Ahmady *et al*,2020).

2.4. Antimicrobial activity

Agar well diffusion method:

The agar well diffusion method was employed for the determination of antimicrobial activity. To brief, wells are made in Nutrient agar plates using cork borer (7 mm diameter) and the inoculums containing 100µl of microbial strains was spread on the plates with the help of glass spreader in an aseptic condition. 20µl,40µl ,60,(T1) and 20µl, 40µl, 60µl (T2) of *Brassica oleracea* extracts; 30mg of standard antibiotics was filled in wells with the help of sterile micropipettes separately. The plates were incubated at 37o c for 24 hours at room temperature. The diameter for the zone of inhibition was measured in millimeter (mm) (Brian *et al*.,2009).

2.5. Secondary metabolite analysis of plant extracts

2.5.1. GC-MS Analaysis

The Clarus 680 GC was used in the study of employed a fused silica column, packed with Elite-5MS (5% biphenyl and 95% dimethylpolysiloxane, 30 m × 0.25 mm ID × 250µm df) and the components are separated using Helium at a constant flow of 1 ml/min. The injector temperature is set at 260°C during the chromatographic run. The 1µL of extract sample injected is into the instrument the oven temperature was as follows: 60 °C (2 min); followed by 300 °C at the rate of 10 °C min and 300 °C, where it was held for 6 min. The mass detector conditions was transfer line temperature 240 °C; ion source temperature 240 °C; and ionization mode electron impact at 70 eV, a scan time 0.2 sec and scan interval of 0.1 sec. The fragments from 40 to 600 Da. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS NIST (2008) library.

2.6. Antioxidant assay of selected plant extracts

2.6.1. Ferric Reducing Antioxidant Power (Frap) Assay:

The assay was based upon the methodology of Benzie and Strain(1996). The FRAP reagent consists of 10 mM TPTZ in 40 mM HCl, 20 mM $FeCl_3$ and 250 mM sodium acetate buffer (pH 3.6). FRAP reagent was freshly prepared by mixing TPTZ solution, $FeCl_3$ solution and acetate buffer in a ratio 1:1:10. A 100 µl of extract solution I added with 900 µl of FRAP reagent. After the mixture stood at 37 °C for 4 minutes, the absorbance at 593 nm was determined against the blank. Ascorbic acid was used as standard. (Ayyappadasan *et al*., 2017), (Rubavathi *et al*., 2020)

$$\%Activity = AControl - Asample\ /AControl \times 100 \quad \textbf{(3)}$$

2.6.2. DPPH ASSAY(2, 2 Diphenyl-1-Picrylhydrazyl Radical Scavenging Assay)

The free radical scavenging capacity of extracts was determined by using DPPH. The DPPH solution (0.006% w/v) is prepared in 95% of methanol. Different concentrations of the test sample which is to be examined for antioxidant activity is prepared (20-100µg/ml). Different concentration of test sample of extracts were mixed with 5 µl of DPPH solution in dark. Ascorbic acid is strong which is a antioxidizing agent is taken as standard. 3 ml of different concentration of standard solution of ascorbic acid was mixed with 5 µl of DPPH solution in dark. The prepared

solution of ascorbic acid and plant extracts samples was incubated for half an hour and then absorbance is taken at 517 nm. Methanol serves as a blank and the experiment was expressed as the inhibition percentage of free radical by the sample and was calculated (Daniela *et al*.,2020)(Rubavathi and ramya, 2016).

$$\%\text{inhibition} = A_{Control} - A_{sample} / A_{Control} \times 100 \quad \textbf{(4)}$$

2.6.3. H_2O_2 Assay

The ability of the extract to scavenge hydrogen peroxide was determined. A solution of hydrogen peroxide (2mmol/l) was prepared in the phosphate buffer (pH 7.4). Extracts (1–10 µg/ml) were added to hydrogen peroxide solution (0.6 ml). The absorbance of the hydrogen peroxide at 230 nm was determined after 10 mins contrary to a blank solution containing phosphate buffer without hydrogen peroxide, compared with ascorbic acid, the reference compound (Ahmady *et al*,2020).

H_2O_2 activity(%) = (Abs control – Abs sample/Abs control) *100 **(5)**

Where, Abs (control): Absorbance of the control

Abs (test): Absorbance of the extracts/standard.

2.6.4. Phosphomolybdate Assay

Total antioxidant activity (TAC) of REE and RME was determined using ascorbic acid as the standard. Phosphomolybdate reagent was prepared by mixing 100 ml of 28 mM sodium phosphate, 100 ml of 0.6 M sulphuric acid and 100 ml of 4 mM ammonium molybdate solutions. To 3 ml of phosphomolybdate reagent, 300 µl of different concentrations (50-250 µg/ml) of extract solutions were added and incubated in the dark room for 90 min at 95°. The absorbance was measured spectrophotometrically at 765 nm (Désiré-Ndayazi *et al*.,2017).

$$\text{TAC \%scavenging} = (A_0 – A_1/A_0) \times 100, \quad \textbf{(6)}$$

where, A_0 is the absorbance of the control after 10 min and A_1 is the absorbance of the sample at 10 min. The concentration of extract at which 50% inhibition is observed (IC_{50}) is calculated in µg/ml.

2.7 Anti Inflammatory Activity

A concentration series of 50, 100 and 250 µg/ml of FELE of P. guajava and Diclofenac sodium was taken as the test sample and the reference drug respectively. The test was performed using six wells for each sample. The absorbances were measured at 255 nm using a multi-mode micro plate reader. The control represents 100% protein denaturation. The test procedure was repeated 6 times. The results were compared with the reference drug. The percentage of inhibition was calculated using the following formula (Fouad *et al*.,2013).

$$\textbf{\% Inhibition} = 100 \text{ X } (V_t/V_c - 1) \quad \textbf{(7)}$$

where, V_t = absorbance of the test sample V_c = absorbance of the control The plant extract concentration for 50% inhibition (IC_{50}) was determined by the dose-response curve.

2.8. Preparation of Herbal Cream

Oil in water (O/W) emulsion-based cream (semisolid formulation) was formulated. The emulsifier (stearic acid) and other oil-soluble components (Cetyl alcohol, almond oil) are dissolved in the oil phase (Part A) and heated to 75° C. The preservatives and other water-soluble components such as Methyl paraban, Propyl paraban, Triethanolamine, Propylene glycol, ethanol extract of Aloe vera, Cucumis sativus and Daucus carota were dissolved in the aqueous phase (Part B) and heated to 75° C. After heating, the aqueous phase was added in portions to the oil phase with continuous stirring until cooling of emulsifier took place (Francisco *et al*.,2011).

3. Results and discussions

3.1.Phytochemical analysis of *Brassica oleracea*

The phytochemical compounds present in petroleum ether, ethyl acetate, methanol and water extracts of *Brassica oleracea* leaves were shown in the table 1 as given below. Alkaloids were absent in all extracts. Flavonoids were present in all extracts which may indicate the presence of antioxidant, anticancer, antimicrobial activity, and nutraceutical applications. Terpenoids were present in water and methanolic extracts which have aromatic qualities and play a role in herbal remedies. Tannins are present in all extracts. Saponin was absent in all extracts which may help to bind proteins. Similar observations were reported by so and metabolites present in the *Brassica oleracea* extracts were compared to the report by (Geetha Surendran *et al*.,2019). Carbohydrates, phenols, proteins and amino acids were present in all extracts.

Table 1. Phytochemical analysis of *Brassica oleracea* variety capitata and *Brassica oleracea*var.botrytis

Compound	*Brassica oleracea*var.capitata				*Brassica oleracea*var.botrytis			
	PE extract	Ethyl acetate extract	CH_4 extract	H_2O extract	PE extract	Ethyl acetate extract	CH_4 extract	H_2O extract
Carbohydrates	+	+	+	+	+	+	+	+
Amino acids	+	+	+	+	+	+	+	+
Tannins	+	+	+	+	+	+	+	+
Flavonoids	+	-	+	+	+	-	+	+
Alkaloids	-	-	-	-	-	-	-	-
Phenols	+	+	+	+	+	+	+	+
Terpenoids	-	-	+	+	-	-	+	+
Saponins	-	-	-	-	-	-	-	-
glycosides	+	+	+	+	+	+	+	+
Proteins	+	+	+	+	+	+	+	+

3.2. Antimicrobial activity

The *B.oleracea* extracts of water, petroleum ether, methanol, ethyl acetate were tested against *E.coli*, *S.aureus*, *K.pneumoniae* and *P.vulgaris* were represented in the Table 2. Chloramphenicol was used as a standard for evaluating the antimicrobial activity of the plant extracts. The Ethyl acetate extract of cabbage showed the maximum zone of inhibition against *E.coli* at 0.7cm and the Water extract of cabbage showed the maximum zone of inhibition against *S.aureus* at 0.7 cm. The methanolic extract of *Brassica oleracea* (cauliflower) variety showed the highest antimicrobial activity against *P.vulgaris* with 0.9 cm. other extracts of *Brassica oleracea* showed no zone of inhibition. In comparison to other extracts, the standard values of both the species *P.vulgaris* and *S. aureus* showed the highest zone of inhibition in comparison with the other organism that is taken into consideration. Methanol extract showed the highest antimicrobial activity (Ayshwarya,and Sudharameshwari, 2015))

3.3. Sun protection factor analysis

SPF is a number given to sunscreen formulation to determine efficacy and is useful when applied at about 2mg/cm^2. In the present work different extracts (petroleum ether, ethyl acetate, methanol and water) of *Brassica oleracea* var.capitata (cabbage) and vari. Botrytis (cauliflower) was estimated the sun protection factor. Compared to other extracts the methanolic extracts of *Brassica oleracea* var.capita showed a high sun protection factor

was indicated in the Table 3. SPF value for sunscreen above - is considered as good sunscreen activity. From both varieties of *Brassica oleracea* the methanolic extracts of cabbage and cauliflower have high sun protection value than other extracts. Both methanolic extracts of *B.oleracea* have the maximum sun protection factor. The SPF analysis was done in triplicates. In three times, methanolic extracts showed high sun protection value. The absorbance values are taken in UV spectrophotometer at 290-320 nm. When the standard value is taken to consider it also shows high SPF for methanolic extracts rather than other extracts. On conclusion gives the methanolic extracts of *B.oleracea* can be used as a source of UV protection formulation.

Table 2. Antimicrobial activity of the *Brassica oleracea* extract

	Cauliflower				**Cabbage**			
Organism	Petroleum ether	Ethyl acetate	Methanol extract	Water extract	Petroleum ether	Ethyl acetate	Methanol extract	Water extract
E.coli	**0.5**	**0.3**	**0.6**	**0.4**	**0.5**	**0.7**	**0.6**	**0.3**
P.vulgaris	**0.2**	**0.4**	**0.9**	**0.6**	**0.1**	**0.12**	**0.1**	**0.1**
S.aureus	**0.1**	**0.1**	**0.2**	**0.3**	**0.2**	**0.4**	**0.6**	**0.7**
K.pneumonia	**0.15**	**0.1**	**0.5**	**0.4**	**0.1**	**0.2**	**0.2**	**0.1**

Table 3. Sun protection factor analysis of 8 extracts of *B.oleracea* cabbage and cauliflower

Name of the extracts	**Wavelength absorbance (nm)**							**Sun protection factor (SPF)**
	290	**295**	**300**	**305**	**310**	**315**	**320**	
EE*I	**0.015**	**0.082**	**0.287**	**0.328**	**0.186**	**0.084**	**0.018**	
Petroleum ether extract of cabbage	1.150	1.162	1.186	1.230	1.271	1.300	1.329	86
Ethyl acetate extract of cabbage	1.140	1.149	1.175	1.207	1.227	1.241	1.261	84
Methanolic extract of cabbage	1.154	1.170	1.196	1.238	1.280	1.312	1.324	87
Aqueous extract of cabbage	1.141	1.150	1.185	1.225	1.270	1.299	1.320	85
Petroleum ether extract of cauliflower	1.150	1.152	1.153	1.154	1.147	1.125	1.031	79
Ethyl acetate extract of cauliflower	1.146	1.151	1.152	1.148	1.139	1.102	0.983	78
Methanolic extract of cauliflower	1.143	1.158	1.182	1.211	1.247	1.275	1.311	85
Aqueous extract of cauliflower	1.139	1.138	1.135	1.118	1.092	1.064	1.081	77

3.4. Antioxidant activity

3.4.1 DPPH ASSAY

The antioxidant activity of *Brassica oleracea was* assessed based on the free radical scavenging effect of the stable free radical DPPH as per the method of (Anandan *et al*., 2018). DPPH assay was carried out for the methanolic extracts *Brassica oleracea* (cauliflower) and *Brassica oleracea* (cabbage) (Fig:3.1).The methanolic extract of *Brassica oleracea* (cauliflower) shows 40 % of inhibition at (40µg/ml) concentration. The methanolic extract of *Brassica oleracea* (cabbage) shows 30% of inhibition at (40µg/ml) concentration (Figure 1). The standard shows 30% inhibition in *Brassica oleracea*(cauliflower) whereas in 25% in *Brassica oleracea* (cabbage) which is moreover similar to the test standard. The standard value is compared with the existing inhibiting value of the compound and found to be 32% at 40 µg/ml concentration (Guriya *et al*.,2015).

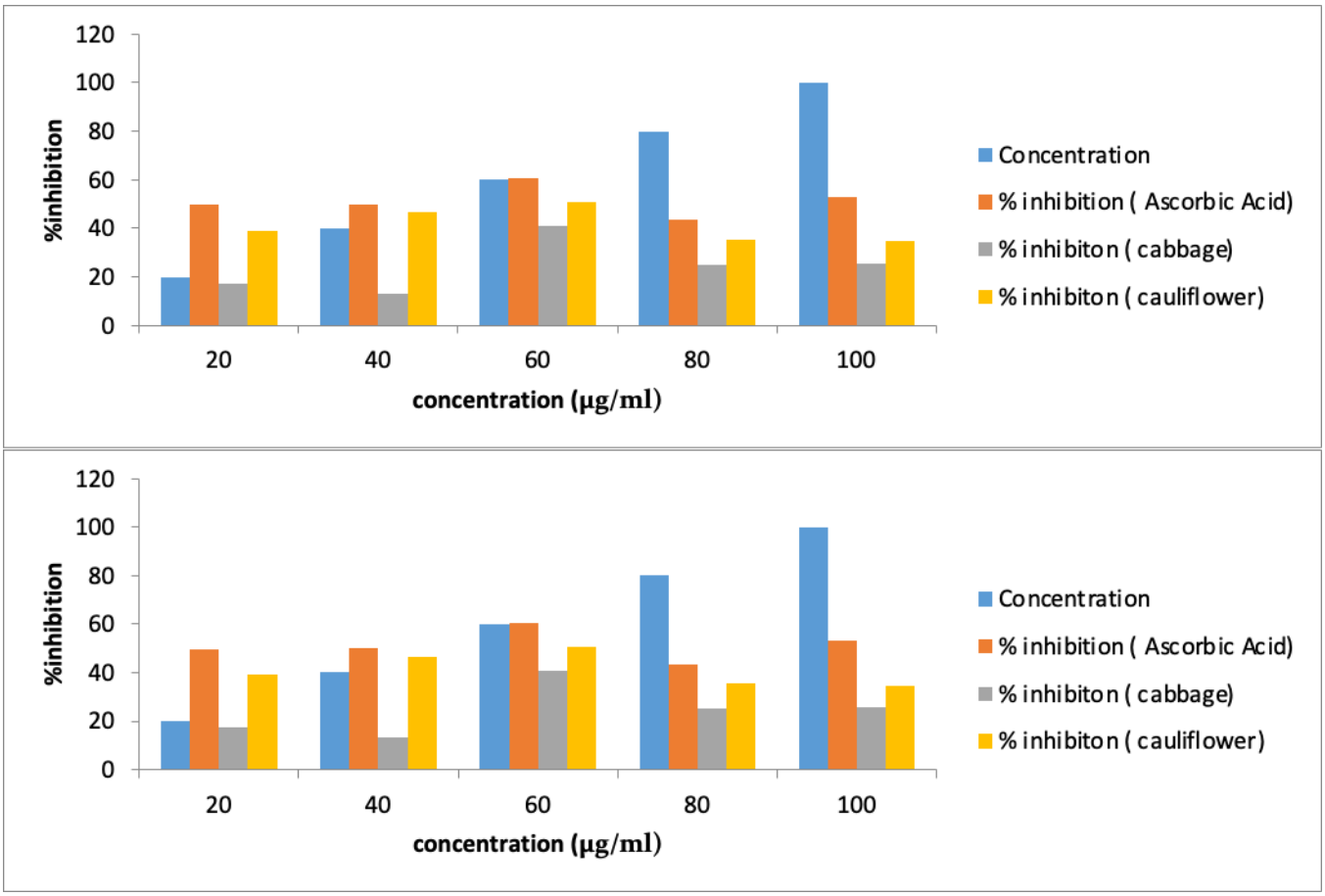


Figure 1. Determination of DPPH assay of *B.oleracea* extracts

3.4.2. Frap Assay

The antioxidant activity of the *Brassica oleracea* (variety capitata and variety botrytis) was done by FRAP assay method .FRAP assay was carried out for the methanolic extracts *Brassica oleracea* (cauliflower) and *Brassica oleracea*. The antioxidant activity of the brassica oleracea (variety capitata and variety botrytis) was done by FRAP assay method (Francisco *et.al*.,2011).FRAP assay was carried out for the methanolic extract of *Brassica oleracea* (cauliflower) shows 40 % inhibition at (100 µg/ml) concentration was described in Figure 2. The methanolic extract of *Brassica oleracea* (cabbage) shows 40 % of inhibition at 80µg/ml concentration in the standard kept for

Brassica oleracea (cauliflower) and *Brassica oleracea* (cabbage) is 35 % of inhibition at (100 µg/ml) concentration and *Brassica oleracea* (cabbage) shows 35 % of inhibition at 80µg/ml concentration (Guriya *et al*.,2015). The standard value is compared with the existing inhibiting value of the compound and found to be little increase in the inhibition activity at 80µg/ml concentration and the standard value is about 40% and at 100 µg/ml the standard activity of inhibition is significant increase about 60% (Guriya *et al*.,2015).

3.4.3. H_2O_2 Assay

H_2O_2 assay was carried out for the methanolic extracts *Brassica oleracea* (cauliflower) and *Brassica oleracea* (cabbage). The methanolic extract of *Brassica oleracea* (cauliflower) shows 61.51 % inhibition at (60µg/ml) concentration. The methanolic extract of *Brassica oleracea* (cabbage) shows 58.55% of inhibition at (60µg/ml) concentration (Figure 3). The standard value is compared with the existing inhibiting value of the compound and found to be a significantly similar activity of inhibition at 60µg/ml concentration and the standard value is about 60% (Guriya *et al*., 2015).

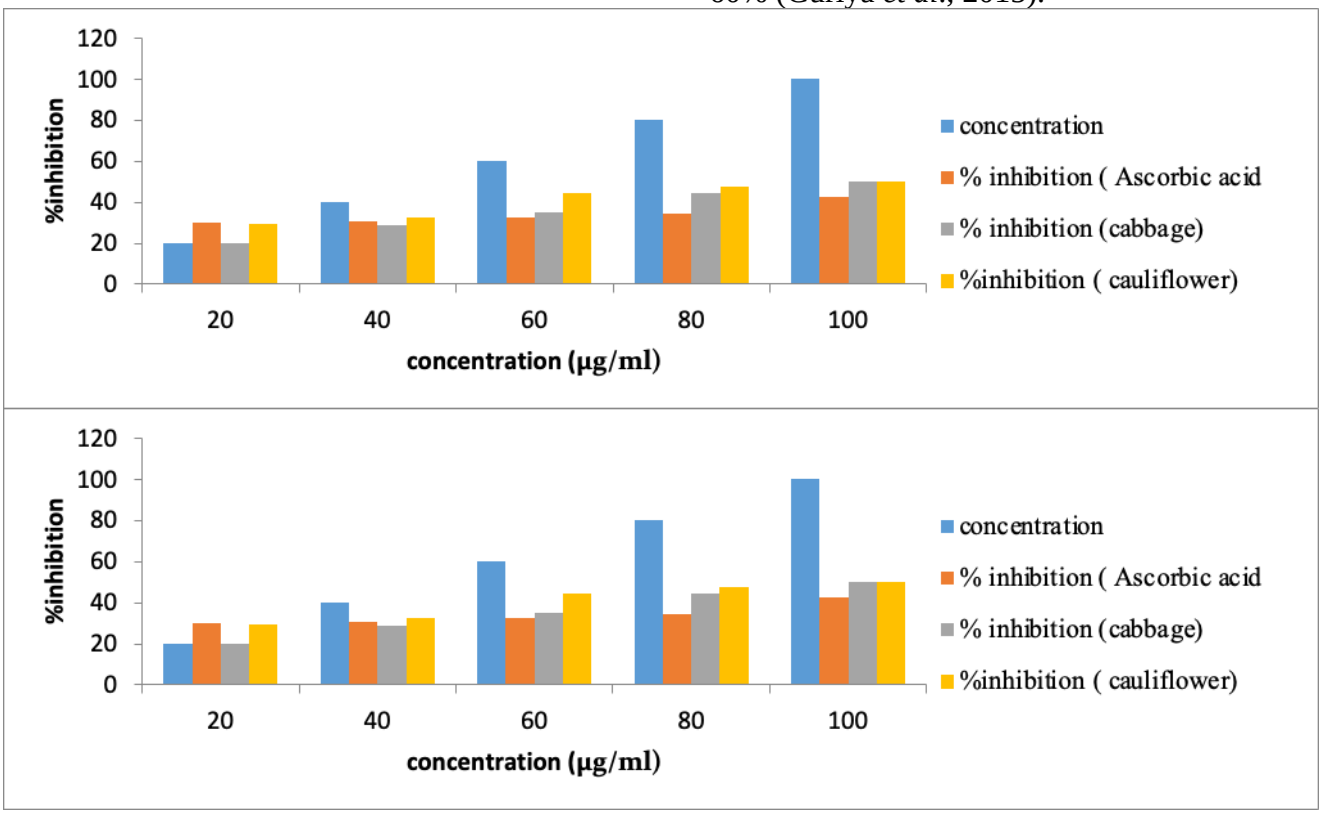
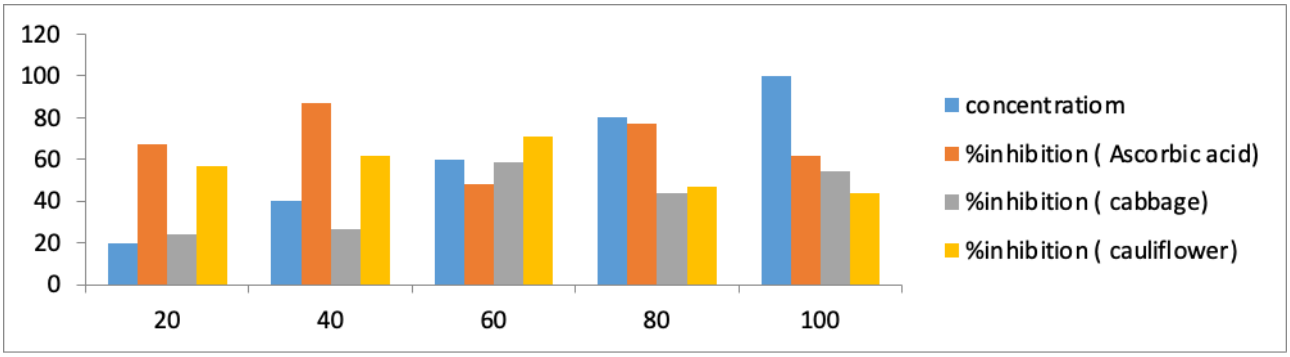


Figure 2. Determination of FRAP assay of *B.oleracea* extracts



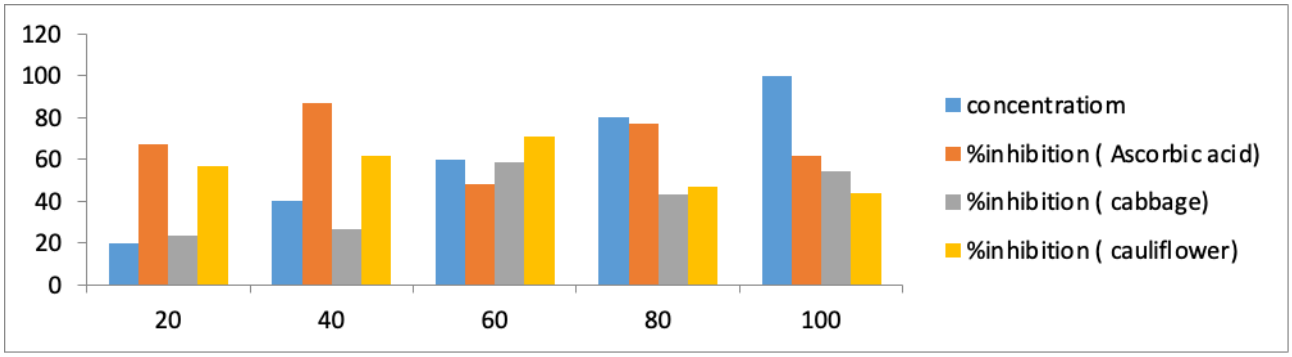


Figure 3. Determination of H_2O_2 assay

3.4.4. Phosphate molybdenum assay

The antioxidant activity of the *Brassica oleracea* was done by phosphate molybdenum assay (Ahmady *et al*,2020). Cauliflower and cabbage show highest antioxidant activity. PM assay was carried out for the methanolic extracts *Brassica oleracea* (cauliflower) and *Brassica oleracea* (cabbage) as represented as Figure 4. The methanolic extract of *Brassica oleracea* (cauliflower) shows 70.76% of inhibition at (60µg/ml) concentration. The methanolic extract of *Brassica oleracea* (cabbage) shows 61.79 % of inhibition at (60µg/ml) concentration. The standard value is compared with the existing inhibiting value of the compound and found to be significantly decreased activity of inhibition at 60µg/ml concentration and the standard value is about 55.5% (Hasan *et al*.,2016), in the standard value too the methanolic extract shows greater range of anti oxidant activity which is same of the test compounds.

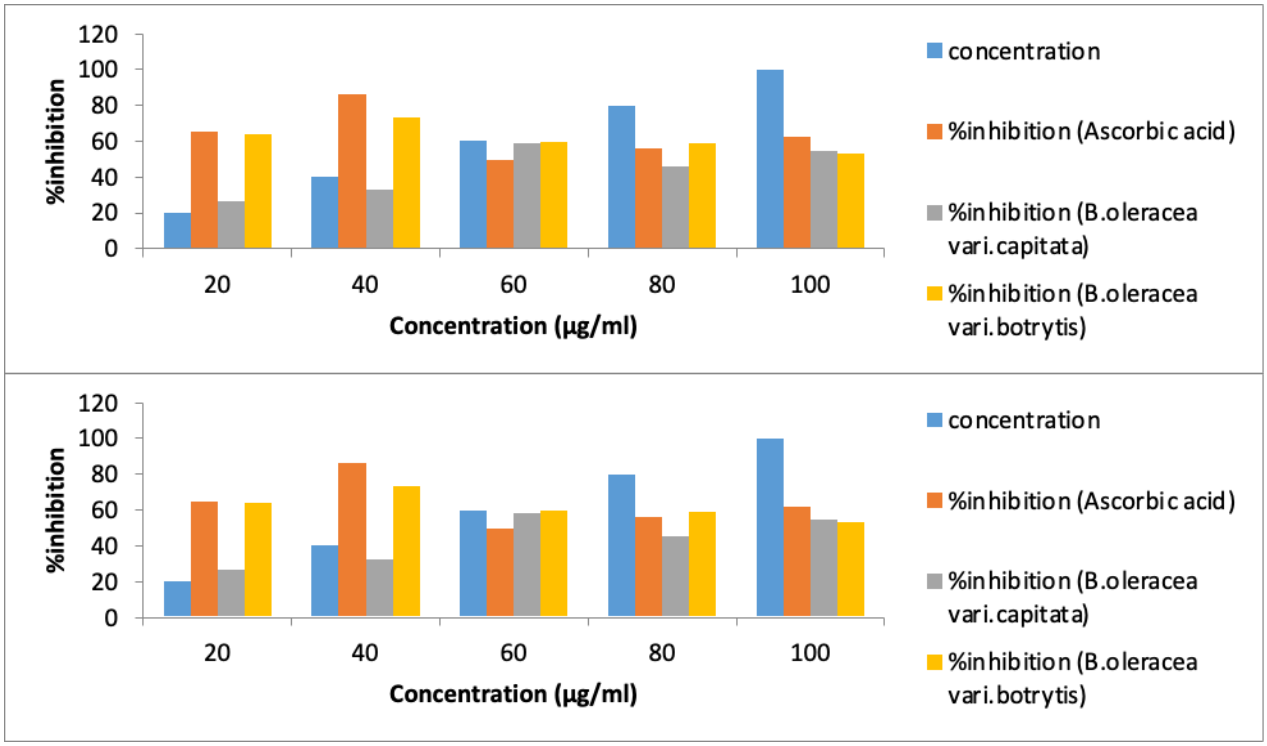


Figure 4. Determination of phosphate molybdenum assay

3.5. Anti inflammatory activity

Anti inflammatory activity was done by bovine serum albumin method (Ahmady *et al*,2020). Anti inflammatory was carried out for the methanolic extracts *Brassica oleracea* (cauliflower) and *Brassica oleracea* (cabbage)

(Figure 4). The methanolic extract of *Brassica oleracea* (cauliflower) shows 70 % of inhibition at (60µg/ml) concentration. The methanolic extract of *Brassica oleracea* (cabbage) shows 53.9% of inhibition at (100µg/ml) concentration. The standard value is compared with the existing inhibiting value of the compound and found to be significantly increased activity of inhibition at 100µg/ml concentration and the standard value is about 56.3% and the activity is decreased to 45% at 60µg/ml concentration (Guriya *et al*.,2015).

3.6. GC-MS ANALYSIS

Gas chromatography-mass spectrometry (GC-MS) was used to identify the secondary metabolites of the plant extracts. GC-MS analysis was done in IIT Bombay ,Powai. We have identified 19 compounds in *Brassica oleracea* variety botrytis.

From the Table 4. GC-MS analysis of *B.oleracea* was tabulated for all compounds and several compounds shows a greater results when compared to the other compounds. The compounds such as n-Hexadecanoic acid, Dodecanoic acid, Cyclohexanone, 4H-Pyran-4one, 2,3-dihydro-3,5,-dihydroxy-6-methyl-, 3-Deoxy-d-mannoic lactone, 1,2,3,-Propanetriol, 1,5-{Hydroxymethyl-2{5H}-furanone, 4H-Pyran-4-one, 2,5-Dimethyl-4-hydroxy-3{2h}-furanone showed show a great results in the range on the area percentage. Notably, the compound 1,2,3,-Propanetriol shows the highest reading on the area percentage. Few other compounds like n-hexadecanoic acid, v2-hexadecen-1-ol, alpha-tocopherol ,phytyl palmitate and pentalene, extracted from B. nigra (Sharma et al. 2018).

Table 4. GC-MS analysis of *B.oleracea* variety botrytis extracts

S.No	Identified compounds *(B.oleracea variety botrytis)*	Molecular formula	RT1 (min)	Area %	% content	[M]+
1.	Hexadecanoic acid	$C_{19}H_{38}O_4$	26.66	8312025.59	1719.83389	330
2.	Octanoic acid, 2-dimethylaminoethyl ester	$C_{12}H_{25}NO_2$	23.45	3107998.49	4599.52067	215
3.	17-Octadecynoic acid	$C_{18}H_{32}O_2$	21.08	1278959.70	11177.296	280
4.	9H-Pyrido[3,4]indole	$C_{11}H_8N_2$	19.29	4226087.02	3382.63345	168
5.	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	18.52	15761614.16	906.969499	256
6.	Z-{13,14-Epoxy}tetradec-11-en-1-ol acetate	$C_{16}H_{28}O_3$	18.26	593790.98	24074.6387	268
7.	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	17.43	2441084.30	5856.12848	296
8.	3`,5'Dimethoxyacetophenone	$C_{10}H_{12}O_3$	13.27	8981171.898	1591.69688	180
9.	Dodecanoic acid	$C_{12}H_{24}O_3$	12.9	19057230.51	750.124909	216
10.	Oleic Acid	$C_{18}O_{34}O_2$	10.94	657500.61	21741.886	282
11.	2-Cyclohexylpiperidine	$C_{11}H_{21}N$	10.48	8338312.66	1714.412	167
12.	Cyclohexanone	$C_{10}H_{14}O$	9.38	15191626.77	940.998849	150
13.	Tridecanonic acid	$C_{15}H_{30}O_3$	9.09	2269100.36	6299.98723	258
14.	2-Furancarboxaldehyde	$C_6H_6O_3$	7.99	14817080.70	964.785411	126
15.	1-Gala-1-ido-octonic lactone	$C_8H_{14}O_8$	7.25	2968822.42	481.512667	238
16.	4H-Pyran-4one, 2,3-dihydro-3,5,-dihydroxy-6-methyl-	$C_6H_8O_4$	6.58	16097077.59	888.068236	144
17.	CIS-2-Ethyl-2-hexan-1-0l	$C_8H_{16}O$	5.56	4021458.22	3554.75614	128
18.	Benzreneacetaldehyde	C_8H_8O	4.95	6449394.38	2216.53	120

19.	1,3-Propanediamine,N'-{ethylcarbonimidoyl}-N,N-dimethyl-	$C_9H_{17}N_3$	4.31	9661655.91	1479.59143	155
20.	Hexadecanoic acid	$C_{19}H_{38}O_4$	26.64	3521989.17	10169.1574	330
21.	Oleic acid	$C_{18}H_{34}O_2$	21.08	10491030.06	3413.93191	282
22.	n- Hexadecanoic acid	$C_{16}H_{32}O_2$	18.48	13468488.53	2659.21913	256
23.	Desulfoglucobrassicin	$C_{16}H_{20}N_2O_6S$	16.80	2585139.29	138.5444	368
24.	3-Deoxy-d-mannoic lactone	$C_6H_{10}0_5$	16.05	20909323	1712.90397	162
25.	3-Deoxy-d-mannoic lactone	$C_6H_{10}0_5$	15.81	25614292.95	1398.26863	162
26.	1,2-{3,4-Dimethoxyphenyl}-6-methyl-3,4-chromanediol#	$C_{18}H_{20}O_5$	13.27	8062767.55	4442.10528	316
27.	d-mannose	$C_6H_{12}O_6$	13.02	3229147.28	11091.3685	180
28.	3-Hydroxylauric acid	$C_{12}H_{24}O_3$	12.56	5070227.17	7063.91668	216
29.	Thioxan-3-one,oxime	C_5H_9NOS	10.90	3439724.10	10412.3648	131
30.	N-Nitroso-2,4,4-trimethyloxazolidine	$C_6H_{12}N_2O_2$	9.70	11474402.29	3121.3532	144
31.	2-Methyl-9-beta-d-ribofuransylhypoxanthine	$C_{11}H_{14}N_4O_5$	9.36	10398241.79	3444.39599	282
32.	1,2,3,-Propanetriol	$C_5H_{10}O_4$	8.64	121668318.17	294.371511	134
33.	2-Furancarboxaldehyde	$C_6H_6O_3$	8.29	11907757.84	3007.7587	126
34.	1,5-{Hydroxymethyl-2{5H}-furanone	$C_5H_6O_3$	7.74	53763650.57	716.388524	114
35.	2(3H)-Furanone	$C_4H_60_3$	7.51	2497618.42	14339.9256	102
36.	4H-Pyran-4-one	$C_6H_6O_4$	7.40	1397618.432	25268.4578	142
37.	4H-Pyran-4-one	$C_6H_6O_4$	6.75	53763650.57	666.16872	142
38.	9-Oxa-bicyclo{3,3,1}nonane-1,4-diol	$C_8H_{14}O_3$	6.28	2497618.42	14339.9256	158
39.	2,5-Dimethyl-4-hydroxy-3{2h}-furanone	$C_6H_8O_3$	5.59	13976408.45	25268.4578	128
40.	2,5-Dimethyl-4-hydroxy-3{2h}-furanone	$C_6H_8O_3$	5.29	10562986.24	3390.67585	128
41..	5-Butyldihydro-2{3H}thiophenone	$C_8H_{14}OS$	5.05	5615685.05	6377.79042	158
42.	2{Hexamethyleneimino}ethanol	$C_8H_{17}NO$	4.32	19899424.73	1799.83378	143

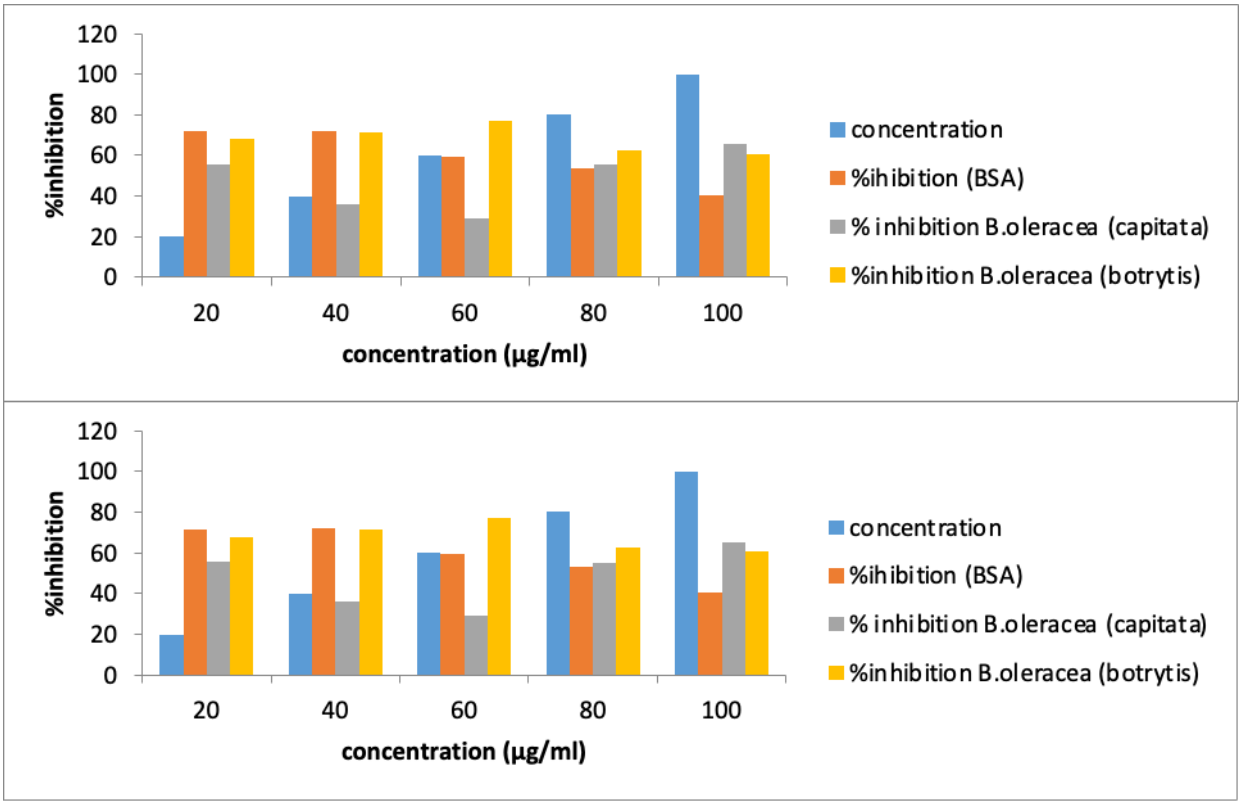


Figure 5. Determination of anti inflammatory activity by BSA method.

Figure 6. Formulation of UV-resistant herbal cream

3.7. Formulation of ultraviolet resistant herbal cream

UV resistant herbal cream, refers to the cream which act as a UV protecting agent. Hence after the extraction of flavonoid compounds the cream was formulated using (Ahmady *et al*,2020). The main ingredients will be Shea butter, aloe vera, coconut oil, almond oil along with bees wax. UV resistant herbal cream was represented as Figure 6.

Content		**Percentage**
Coconut Oil	-	10
Almond Oil	-	10
Water	-	25
Methanolic Extract (Cabbage)	-	7.5
Methanolic Extract (Cauliflower)	-	7.5
Beeswax	-	20
Shea Butter	-	20

4. Conclusions

The present study focused on collection of Brassicaceous plant leaves (*B.oleracea* variety.*capitata*,variety *botrytis*) to extract the sinapate ester derivatives and flavonoid compounds in low production cost to give an herbal cream containing UV resistant properties for persons who are affected by Ultraviolet

rays. The leaves were collected and extracted the UV-resistant compounds using different solvents like petroleum ether, ethyl acetate, Methanol and water. The extracts were dried using Petri dishes and stored at room temperature. Then the extractive value can be calculated. Estimation of Antibacterial activity, The Ethyl acetate extract of cabbage showed the maximum zone of inhibition against *E.coli* with 0.7 cm, and the Water extract of cabbage showed the maximum zone of inhibition against S.aureus with 0.7 cm.. The methanolic extract of *Brassica oleracea* (cauliflower) variety showed the highest antimicrobial activity against *P.vulgaris* with 0.9 cm. other extracts of brassica oleracea showed no zone of inhibition. The Methanol extract showed the highest antimicrobial activity. And sun protection factor analysis was carried out for the four different extracts. The compounds such as n-Hexadecanoic acid, Dodecanoic acid, Cyclohexanone, 4H-Pyran-4one, 2,3-dihydro-3,5,-dihydroxy-6-methyl-, 3-Deoxy-d-mannoic lactone, 1,2,3,-Propanetriol, 1,5-{Hydroxymethyl-2{5H}-furanone, 4H-Pyran-4-one, 2,5-Dimethyl-4-hydroxy-3{2h}-furanone showed show great results in the range on the area percentage in GC-MS analysis. The highest sun protection factor showed in methanolic extracts. Evaluating the antioxidant activity by DPPH, FRAP, H_2O_2 and phosphate molybdenum methods. Then the UV resistant compound has rich in the antioxidant property. The anti inflammatory activity also carried out by bovine serum albumin method. The maximum inhibition was obtained in both *Brassica oleracea* variety capitata (cabbage), and *Brassica oleracea* variety botrytis (cauliflower). Nearly 1g of extracts are produced in an extraction process. The cream without extract and the cream with extract pH can be calculated using pH meter. The without-extract cream pH is 4.2. Finally, the physicochemical properties of the cream were analyzed.

5. References

Ahmady, A., Amini, M. H., Zhakfar, A. M., Babak, G.,Sediqi, M. N. (2020). Sun Protective Potential and Physical Stability of Herbal Sunscreen Developed from Afghan Medicinal Plants. *Turkish Journal of Pharmaceutical Sciences*, 17(3), 285.

Amandine, L., Flourat , Gaëlle ,W., Andreia, R.S., Teixeira , Florent, A. (2019). Eco-Friendly Extraction of Sinapine From Residues of Mustard Production, *Frontiers in Sustainable Food Systems*,3:12

Anandan, S., Syeda, F.S., Mahadeva, M.,J., Urooj.(2018).Glucosinolates and Antioxidant Properties of *Brass-ica Oleracea* var. capitata L. *Food Science and Nutrition Technology*, 3(3), 2574-2701.

Ashish, A., Mohini, K., Abhiram Rout. (2013).Preparation and evaluation of polyherbal cosmetic cream. *Scholars Research Library*, 5 (1),83-88.

Assunta ,R., Angela ,E.,Ganna ,P., Daria ,M., Amalia ,B.,Manuela,R. Bioactive Compounds in Brassicaceae Vegetables with a Role in the Prevention of Chronic Diseases. *Molecules* ,23(15).

Ayshwarya, M ,Sudharameshwari,K.(2015). Antimicrobial activity of the plant extracts of *Brassica oleracea* var. *Capitata rubra .Journal of International Academic Research for Multidisciplinary*,3(10),2320-5083. Not cited in ms text

Ayyappadasan, G., Deepak kumar,P., Rubavathi, S. and Uthira, M. (2017). Metabolite profiling and an in-vitro assessment of antimicrobial and antioxidant activities of lichen Ramalina inflata, International Research Journal of Pharmacy, Vol. 7, No. 12, pp.132-138.

Benzie, I.F., Strain, J.J. (1996). The ferric reducing ability of plasma (FRAP) as a measure of antioxidant power: The FRAP Assay. *Analytical Biochem*istry. 239,70-76.

Bhattacharya, S., Sherje, A. P.(2020). Development of resveratrol and green tea sunscreen formulation for combined photoprotective and antioxidant properties. *Journal of Drug Delivery Science and Technology*,60,102000.

Brian, M., Fahlma,S., Krol .(2009). UVA and UVB radiation-induced oxidation products of quercetin. *Journal of Photochemistry and Photobiology B: Biology*, 97(3),123–131.

Daniela, R., Angel, A., Vanesa, B., Alejandra, C., Diego, A., Moreno.(2020) . Functional Ingredients From Brassicaceae Species: Overview and Perspectives. *International Journal of Molecular Sciences*, 21,1998.

Désiré-Ndayazi, Félicien,M.K.,Ngoupayo ,J., Yassa,P., Jean-Marie,V.,Tshimbila ,K.(2017). Phytochemical screening and antibacterial properties of hydroalcoholic and ethanolic extracts from *Brassica olerea* L. *IOSR Journal of pharmacy*,7(12),38-43.

Fouad, A.,Rehab, F., Ali.(2013). Bioactive Compounds and Antioxidant Activity of Fresh and Processed White Cauliflower. *BioMed Research International*, 367819.

Francisco, C., Morgane, G., Marie-Andrée ,E.(2011). Evaluation of the antioxidant potential of cauliflower (*Brassica oleracea*) from a glucosinolate content perspective. *Elsevier*, *Food Chemistry* ,132(2),1003–1009.

Geetha ,S., Mackenzie, M., Peter, Z., Ilirian, D.(2019). Assessment of Hydroxycinnamic Acids Potential for Use as Multifunctional Active Ingredients in Sunscreens, Via a Comparative UV Spectroscopy Analysis.*Journal of Chemical and Pharmaceutical Research*,11(9),37-44.

Guriya, R., Moon, A., Talreja, K. (2015).Phytochemical Profiling and Characterization of Bioactive Compounds from *Brassica oleracea*. *International Journal of Pharmacognosy and Phytochemical Research* ,7(4); 825-831.

Hasan, H., Sevtap-Aydin, O., Nurşen, B. (2016). Sinapic Acid: Is It Safe for Humans?, fabad *Journal of Pharmaceutical Science*, 41, 39-49.

Rubavathi , S., Ayyappadasan, G., Sangeetha, N., Harini, T., Saranya, D., Harshapradha, P. (2020). Studies on Antioxidant and Anti-obesity Activity of Salvia hispanica (Chia) Seeds Extracts, Journal of Drug Delivery and Therapeutics, 10(3-s), pp. 98-106.

Rubavathi, S, and Ramya, M. (2016). Invitro Assessment of Antimicrobial and Antioxidant Activity of Bioactive Compounds from Marine Algae, International Journal of Current Microbiology and Applied Sciences, 5(7): 253- 266.

Sharma, A., Rai,P.K .,Surenthra,P.(2018). GC-MS detection and determination of major volatile compounds in *Brassica juncea* L.leaves and seeds. *Microchemical Journal*.138,488- 493.

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