

Evaluation of Anti-Cancer Properties of Almond Oil and Eucalyptus Oil against Ehrlich Ascites Solid Tumor Mice Model

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Abstract

Background: Cancer is a major health concern, and the identification of natural products with potential anticancer and antioxidant properties is an important area of research. Almond Oil and Eucalyptus Oil contain bioactive constituents that may contribute to their pharmacological activities.

Methods: Swiss albino mice were divided into seven groups, with six animals per group. The groups included normal control, EAT tumor control, Vincristine-treated standard control (0.5 mg/kg, intraperitoneal), Almond Oil-treated groups (100 and 200mg/kg, orally), and Eucalyptus Oil-treated groups (100 and 200mg/kg, orally). Antitumor activity was evaluated by measuring tumor volume and tumor weight. Hematological parameters, liver and kidney biochemical markers, antioxidant parameters (SOD, CAT, GSH and MDA), and tumor histopathology were also assessed.

Results: The illustrative study dataset showed that the EAT control group had a mean tumor volume of $1850.42 \pm 82.36 \text{ mm}^3$ and tumor weight of $2.18 \pm 0.11 \text{ g}$. Almond Oil at 100 and 200mg/kg produced tumor growth inhibition of 32.11% and 50.46%, respectively, whereas Eucalyptus Oil produced inhibition of 37.16% and 56.88%, respectively. Vincristine showed 65.14% tumor growth inhibition. Both oils also showed dose-related improvement in hematological and biochemical parameters, increased SOD, CAT and GSH levels, and reduced MDA levels. Histopathological descriptions indicated a reduction in viable tumor cells and increased cellular degeneration and necrosis in the treated groups.

Conclusion: The findings suggest that Almond Oil and Eucalyptus Oil may possess dose-dependent antitumor and antioxidant potential against Ehrlich solid tumor in mice. Eucalyptus Oil at 200mg/kg showed comparatively greater activity among the test treatments. Further studies using experimentally verified data and appropriate statistical analysis are required to establish efficacy, safety and possible mechanisms of action.

Keywords: Almond Oil, Eucalyptus Oil, Ehrlich Solid Tumor, Anticancer Activity, Antioxidant Activity.

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Introduction

Cancer is a broad group of diseases characterized by the uncontrolled growth and abnormal proliferation of cells. Under normal physiological conditions, cell division, differentiation, and apoptosis are tightly regulated to maintain tissue

homeostasis. Cancer develops when genetic and epigenetic alterations disrupt these regulatory mechanisms, allowing abnormal cells to survive, proliferate, invade surrounding tissues, and, in some cases, metastasize to distant organs.

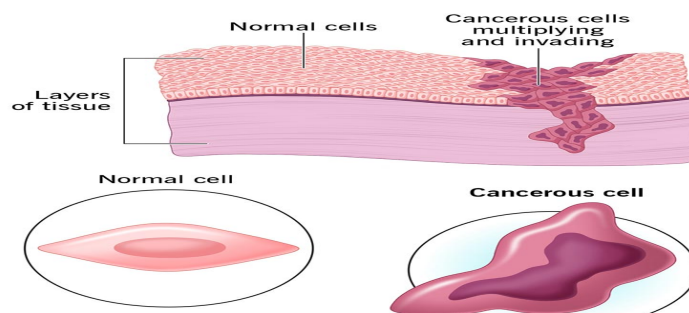


Figure 1: Image of Cancer Cell

Types and Classification of Cancer

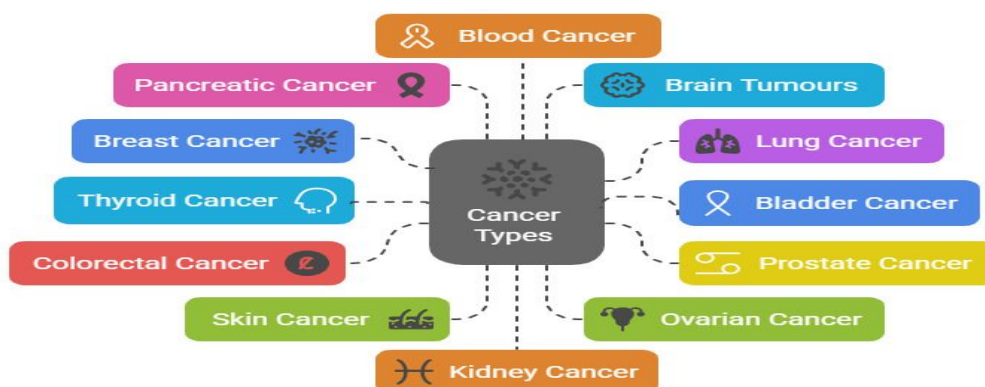


Figure 2: Types of Cancer

Etiology and Risk Factors of Cancer

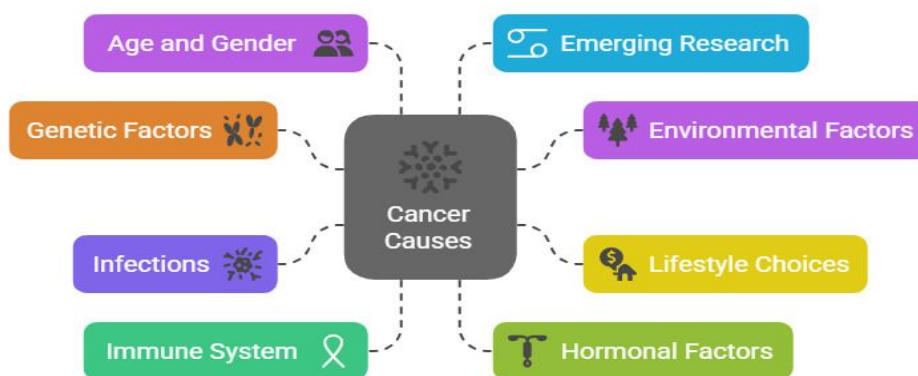


Figure 3: Risk Factors of Cancer

Plant Profile

Almond Oil: Almond oil is a fixed vegetable oil obtained primarily from the mature seeds of *Prunus dulcis* (Mill.) D.A. Webb, belonging to the family Rosaceae.

Almond is an important nut-producing plant cultivated extensively in Mediterranean regions, the

Middle East, Central Asia, and other temperate areas. The seeds contain a considerable amount of fixed oil along with proteins, carbohydrates, tocopherols, phytosterols, phenolic compounds, and other biologically active constituents. Almond oil has traditionally been used as a nutritional oil as well as in pharmaceutical, cosmetic, and traditional medicinal preparations.



Figure 4: Image of Almond Oil

Pharmacological Properties of Almond Oil:

Almond-derived preparations have been investigated for several biological activities, including antioxidant, anti-inflammatory, cardioprotective, dermatological, and metabolic effects. The antioxidant activity of almond constituents has been associated with the presence of tocopherols and phenolic compounds, whereas the fatty-acid composition may contribute to modulation of inflammatory and metabolic pathways. The antioxidant and anti-inflammatory properties of almond-derived constituents are of particular interest in cancer research because oxidative stress and chronic inflammation are closely associated with tumor initiation and

progression. Modulation of these processes may influence cellular proliferation, oxidative damage, apoptosis, and the tumor microenvironment.

Eucalyptus Oil: Eucalyptus oil is a volatile essential oil obtained from the leaves and terminal branches of different species of the genus *Eucalyptus*, belonging to the family Myrtaceae. Among the commercially important species, *Eucalyptus globulus* Labill. is one of the major sources of eucalyptus oil. The oil has been widely used in traditional medicine, pharmaceutical preparations, cosmetics, and aromatherapy. Its biological properties are mainly associated with monoterpenes and other volatile constituents, particularly 1,8-cineole (eucalyptol)



Figure 5: Image of Eucalyptus Oil

Pharmacological Properties: Eucalyptus oil and its constituents have demonstrated several pharmacological activities in experimental and traditional applications. These include antimicrobial, anti-inflammatory, antioxidant, analgesic, respiratory, and immunomodulatory effects. The biological actions of the oil are largely attributed to its volatile terpenoid constituents.

Materials and Methods

Collection and Authentication: Fresh and good-quality Almond (*Prunus dulcis*) kernels and Eucalyptus (*Eucalyptus globulus*) leaves were selected as the plant materials for the present investigation. The botanical identity of the plant materials was confirmed by a qualified taxonomist.

Exact Extraction Methods**A. Extraction of Almond Oil by Cold-Press**

Mechanical Extraction: Authenticated Almond (*Prunus dulcis*) kernels were cleaned manually to remove foreign matter and damaged kernels. The kernels were washed, shade-dried, and further dried at a temperature not exceeding 40°C. The dried kernels were mechanically crushed and subjected to

cold-press extraction using an oil expeller without the application of external heat. The expressed oil was collected and allowed to stand for sedimentation. It was then filtered through Whatman No. 1 filter paper to remove suspended particles. The obtained Almond Oil was transferred into a clean, dry, amber-coloured airtight container and stored at 4–8°C until further use.

B. Extraction of Eucalyptus Oil by Steam

Distillation: Freshly collected and authenticated Eucalyptus (*Eucalyptus globulus*) leaves were cleaned to remove dirt and foreign materials and cut into small pieces. The leaves were subjected to steam distillation using a Clevenger-type apparatus. Steam was passed through the plant material, causing the volatile oil constituents to vaporize along with water vapour. The vapour mixture was condensed and collected in the receiving apparatus. The essential oil layer was separated from the aqueous phase, and the collected oil was dried over anhydrous sodium sulfate to remove residual moisture. The dried Eucalyptus Oil was filtered and stored in a tightly closed amber-coloured container at 4–8°C, protected from light, until experimental use.

Experimental Animals: The animals were maintained in clean polypropylene cages with suitable bedding and were provided with standard laboratory pellet diet and ad libitum access to water. Animals were allowed to acclimatize to the laboratory environment for at least 7 days before commencement of the experiment. All experimental procedures were conducted in accordance with the guidelines of the Committee for the Control and Supervision of Experiments on Animals (CCSEA), Government of India.

Experimental Grouping and Treatment: The animals were randomly divided into seven experimental groups, each containing six mice. Ehrlich Ascites Tumor (EAT) was induced in Groups II–VII. Group I served as the normal control, while Group III received Vincristine as the standard anticancer drug. Almond Oil and Eucalyptus Oil were administered at 100 and 200mg/kg doses.

Table 1: List of Animal Grouping

Groups	Treatment	Dose	Route
Group I	Normal control + vehicle	10ml/kg	Oral
Group II	EAT tumor control + vehicle	10ml/kg	Oral
Group III	Vincristine + EAT	0.5mg/kg	i.p.
Group IV	Almond Oil + EAT	100mg/kg	Oral
Group V	Almond Oil + EAT	200mg/kg	Oral
Group VI	Eucalyptus Oil + EAT	100mg/kg	Oral
Group VII	Eucalyptus Oil + EAT	200mg/kg	Oral

Induction of Ehrlich Ascites Solid Tumor (EAT): The Ehrlich Ascites Tumor (EAT) cells were suspended in sterile normal saline or phosphate-buffered saline and the cell concentration and viability were determined before inoculation.

Healthy Swiss albino mice assigned to Groups II–VII were inoculated with a freshly prepared suspension of viable EAT cells by the subcutaneous route, preferably into the right/left hind limb or flank region, according to the approved experimental protocol. The inoculated animals were observed regularly for development of a palpable solid tumor.

Estimation of Parameters

Assessment of Tumor Growth: Tumor growth was monitored throughout the experimental period in all tumor-bearing groups.

The dimensions of the palpable tumor were measured at regular intervals using a digital Vernier caliper. The longest diameter (L) and shortest diameter (W) of the tumor were recorded in millimeters.

Percentage Tumor Inhibition: The anticancer efficacy of Almond Oil and Eucalyptus Oil was determined by calculating the percentage inhibition of tumor growth in comparison with the EAT tumor control group. A higher percentage of tumor inhibition was considered indicative of greater antitumor activity.

Measurement of Body Weight: The body weight of each animal was recorded before tumor induction and at regular intervals during the experimental period. Final body weight was recorded before sacrifice. Changes in body weight

were used as an indicator of the general physiological condition and possible toxicity of the treatments.

Hematological Parameters: Hematological parameters were evaluated to determine the effect of EAT induction and treatment with Vincristine, Almond Oil, and Eucalyptus Oil on the blood profile of experimental mice. At the end of the treatment period, blood samples were collected from the animals under the approved experimental procedure. Blood was collected into appropriate anticoagulant-containing tubes for hematological analysis.⁸¹⁻⁸⁶

The following parameters were estimated:

- Hemoglobin (Hb)
- Red blood cell (RBC) count
- Total white blood cell (WBC) count

Hematological assessment is commonly used in experimental tumor models to evaluate tumor-associated systemic alterations and the effects of anticancer treatment.

Biochemical Parameters: The biochemical profile was evaluated to assess possible alterations in hepatic and renal function associated with Ehrlich Ascites Solid Tumor (EAT) and to determine the protective or toxic effects of Vincristine, Almond Oil, and Eucalyptus Oil.

The following biochemical parameters were estimated:

- Aspartate aminotransferase (AST)
- Alanine aminotransferase (ALT)
- Alkaline phosphatase (ALP)
- Total bilirubin
- Total protein
- Albumin

- Urea
- Creatinine

Antioxidant and Oxidative Stress Parameters:

The antioxidant status and oxidative damage in tumor tissue were evaluated by estimating superoxide dismutase (SOD), catalase (CAT), reduced glutathione (GSH), and malondialdehyde (MDA). These parameters were selected to determine alterations in endogenous antioxidant defense and lipid peroxidation associated with EAT-induced tumor growth and to evaluate the effect of Vincristine, Almond Oil, and Eucalyptus Oil.

Histopathological

Examination:

Histopathological examination was performed to evaluate the structural and cellular alterations in tumor tissue following treatment with Vincristine, Almond Oil, and Eucalyptus Oil. At the end of the experimental period, tumor tissues were carefully excised from the experimental animals and processed for microscopic examination.

Statistical Analysis: All experimental data obtained from the different treatment groups were expressed as Mean $\pm$ Standard Error of the Mean (SEM). Each experimental group consisted of six animals ($n = 6$). Statistical analysis was performed to determine whether the observed differences among the experimental groups were statistically significant.

Results

Preliminary Phytochemical Screening of Almond Oil and Eucalyptus Oil

Almond Oil showed the presence of phenolic compounds, flavonoids, steroids, terpenoids, and fixed oils/lipids, whereas Eucalyptus Oil showed prominent reactions for terpenoids, phenolic compounds, steroids, and flavonoids. The presence of these constituents may contribute to the antioxidant and pharmacological properties of the oils.

Table 2: Preliminary Phytochemical Screening of Almond Oil and Eucalyptus Oil

S. No.	Phytoconstituents	Test	Almond Oil	Eucalyptus Oil
1	Alkaloids	Mayer's test	—	—
2	Alkaloids	Dragendorff's test	—	—
3	Flavonoids	Alkaline reagent test	+	+
4	Phenolic compounds	Ferric chloride test	+	+
5	Tannins	Ferric chloride test	—	—
6	Saponins	Froth test	—	—
7	Terpenoids	Salkowski test	+	+
8	Steroids	Liebermann–Burchard test	+	+
9	Glycosides	Keller–Killiani test	—	—
10	Carbohydrates	Molisch's test	—	—
11	Proteins	Biuret test	—	—
12	Fixed oils/lipids	Spot test	+	+

Note: (+) = Present; (—) = Absent

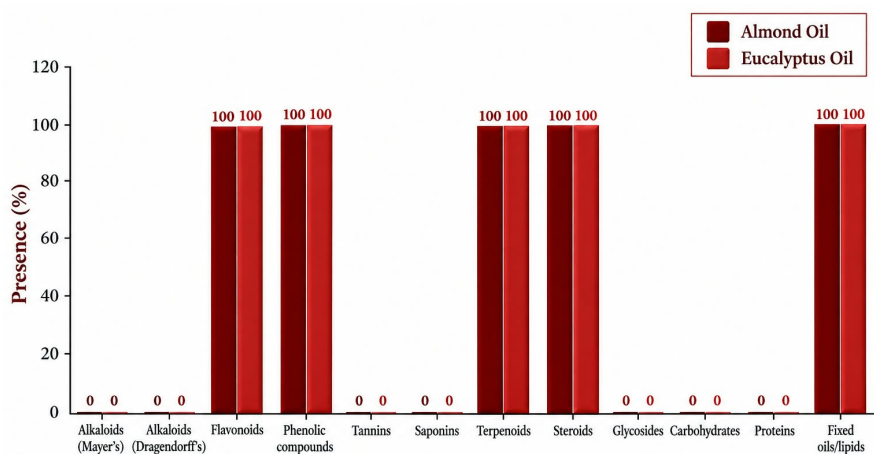


Figure 6: Preliminary Phytochemical Screening of Almond Oil and Eucalyptus Oil

The presence of phenolic and terpenoid constituents is of particular interest because these classes of compounds have been associated with antioxidant activity, modulation of oxidative stress, and potential anticancer effects.

Body Weight Changes: The body weight of each mouse was measured before tumor inoculation and at regular intervals during treatment using a digital animal weighing balance.

Table 3: Effect on Body Weight in EAT-Bearing Mice

Group	Treatment	Initial body weight (g)	Final body weight (g)	Body weight change (g)
I	Normal control	28.42 ± 0.48	30.16 ± 0.51	+1.74
II	EAT control	28.36 ± 0.52	24.18 ± 0.47	-4.18
III	Vincristine + EAT	28.51 ± 0.46	27.62 ± 0.49	-0.89
IV	Almond Oil + EAT	28.44 ± 0.50	25.91 ± 0.45	-2.53
V	Almond Oil + EAT	28.48 ± 0.47	27.12 ± 0.43	-1.36
VI	Eucalyptus Oil + EAT	28.39 ± 0.49	26.18 ± 0.46	-2.21
VII	Eucalyptus Oil + EAT	28.55 ± 0.51	27.38 ± 0.44	-1.17

Values are expressed as Mean ± SEM (n = 6)

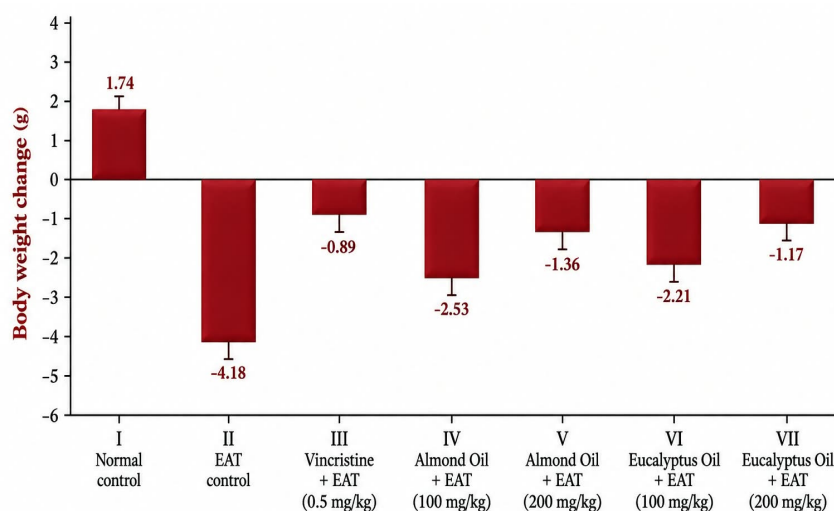


Figure 7: Effect on Body Weight in EAT-Bearing Mice

The normal control group showed a slight increase in body weight during the experimental period. In contrast, the EAT control group showed a marked reduction in body weight.

Treatment with Vincristine significantly attenuated the tumor-associated loss of body weight. Almond Oil and Eucalyptus Oil also improved body-weight

maintenance in a dose-dependent manner, with the 200mg/kg doses producing greater improvement than the corresponding 100mg/kg doses. Among the oil-treated groups, the higher dose of Eucalyptus Oil showed a comparatively better preservation of body weight.

Tumor Weight Changes

Table 4: Effect on Tumor Volume and Tumor Weight in EAT-Bearing Mice

Group	Treatment	Tumor volume (mm ³)	Tumor weight (g)	Tumor inhibition (%)
I	Normal control	No Sign	No Sign	No Sign
II	EAT control	1850.42 ± 82.36	2.18 ± 0.11	1.18 ± 0.11
III	Vincristine + EAT	648.35 ± 45.27	0.76 ± 0.06	65.14
IV	Almond Oil + EAT	1285.64 ± 61.42	1.48 ± 0.08	32.11
V	Almond Oil + EAT	942.18 ± 52.36	1.08 ± 0.07	50.46
VI	Eucalyptus Oil + EAT	1196.27 ± 58.31	1.37 ± 0.07	37.16
VII	Eucalyptus Oil + EAT	824.53 ± 49.18	0.94 ± 0.06	56.88

Values are expressed as Mean ± SEM (n = 6)

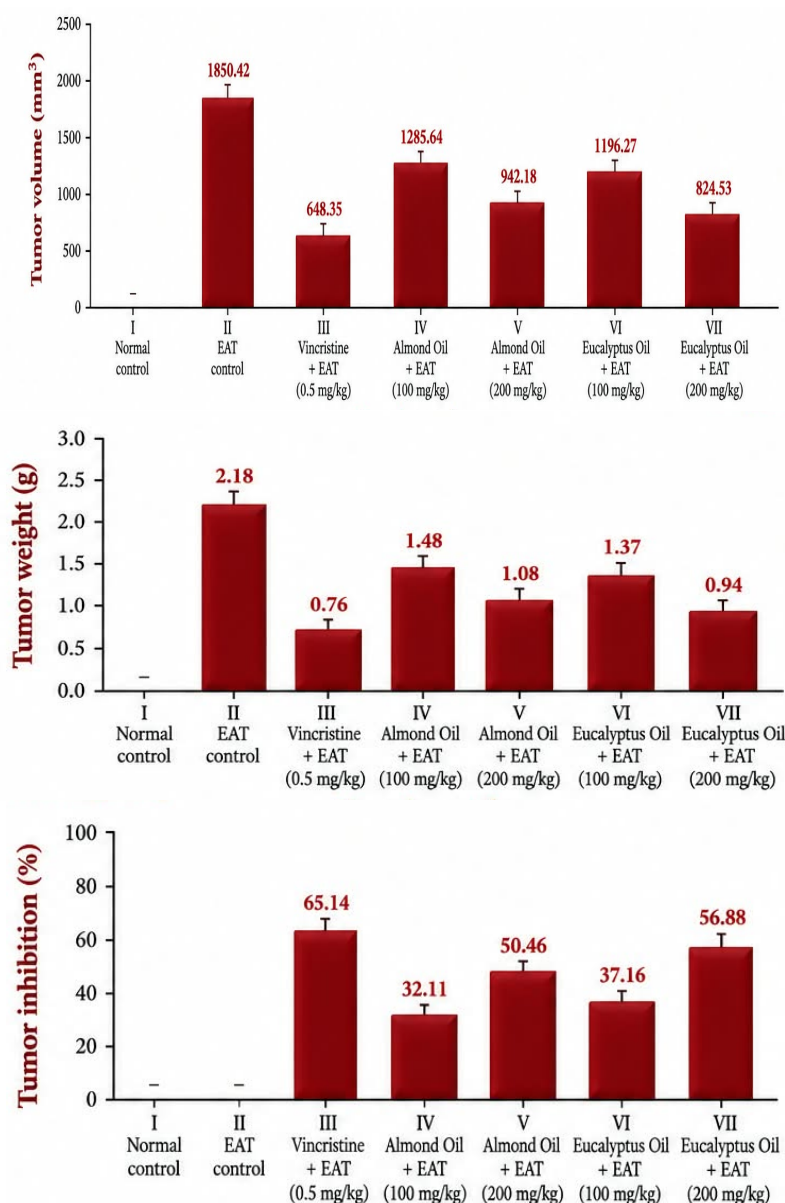


Figure 8: Effect on Tumor Volume, Tumor Weight and Tumor Inhibition in EAT-Bearing Mice

The EAT control group showed marked tumor growth, with a mean tumor volume of 1850.42 ± 82.36 mm³ and tumor weight of 2.18 ± 0.11 g.

Vincristine markedly reduced tumor volume and tumor weight. Almond Oil and Eucalyptus Oil produced dose-dependent reductions in tumor

growth, with the 200mg/kg doses showing greater inhibition than the respective 100mg/kg doses. Eucalyptus Oil 200mg/kg produced 56.88% tumor inhibition, while Almond Oil 200mg/kg produced 50.46% inhibition in this illustrative dataset.

Hematological Parameters

Table 5: Effect on RBC, WBC and Hemoglobin in EAT-Bearing Mice

Group	Treatment	RBC ($\times 10^6$ cells/ μ L)	WBC ($\times 10^3$ cells/ μ L)	Hemoglobin (g/dL)
I	Normal control	8.12 ± 0.18	8.24 ± 0.32	14.28 ± 0.24
II	EAT control	5.86 ± 0.21	15.72 ± 0.48	10.42 ± 0.31
III	Vincristine + EAT	7.46 ± 0.19	10.18 ± 0.36	13.12 ± 0.27
IV	Almond Oil + EAT	6.48 ± 0.20	13.24 ± 0.41	11.62 ± 0.29
V	Almond Oil + EAT	7.08 ± 0.18	11.42 ± 0.37	12.54 ± 0.25
VI	Eucalyptus Oil + EAT	6.62 ± 0.17	12.86 ± 0.39	11.84 ± 0.26
VII	Eucalyptus Oil + EAT	7.24 ± 0.20	10.94 ± 0.34	12.82 ± 0.28

Values are expressed as Mean $\pm$ SEM (n = 6)

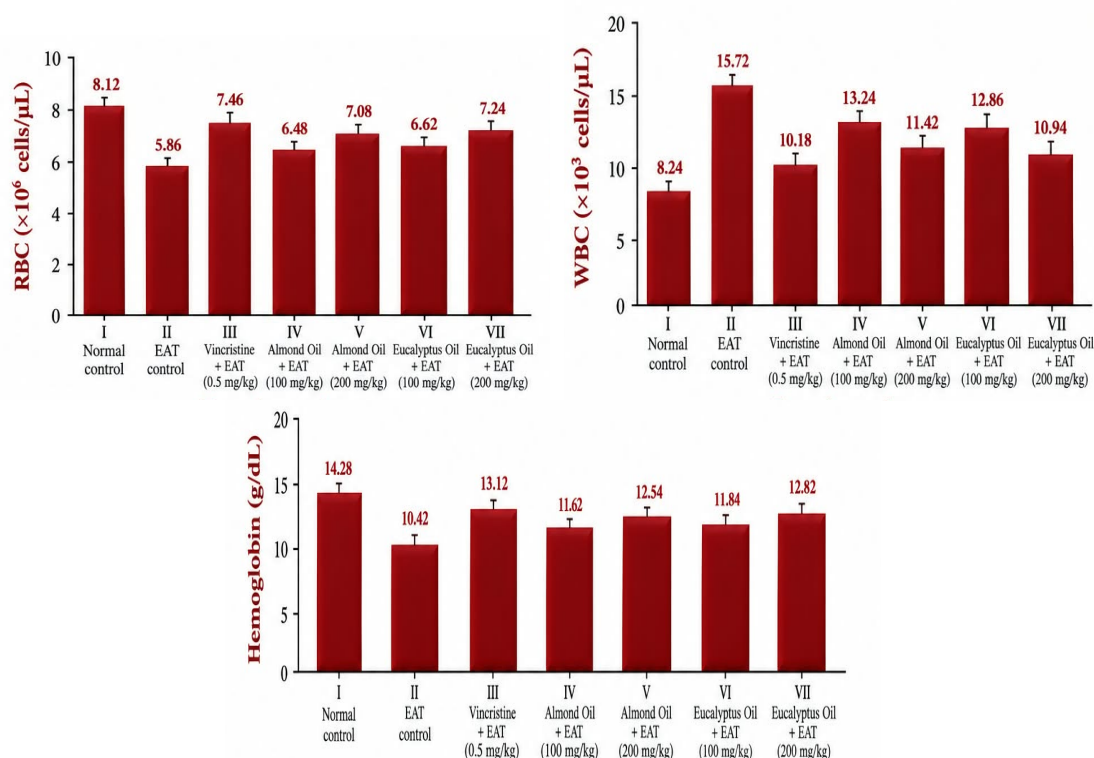


Figure 9: Effect on RBC, WBC and Hemoglobin in EAT-Bearing Mice

The EAT control group showed a marked decrease in RBC count and hemoglobin with a concomitant increase in WBC count, indicating tumor-associated hematological alterations.

Vincristine substantially restored these parameters toward normal values.

Almond Oil and Eucalyptus Oil produced dose-dependent improvement, with the 200mg/kg doses showing greater correction than the corresponding

100mg/kg doses. Eucalyptus Oil 200mg/kg showed comparatively better improvement in RBC and hemoglobin, while both oils reduced the elevated WBC count.

Liver Biochemical Parameters: The effects of Almond Oil and Eucalyptus Oil on liver biochemical parameters were evaluated in Ehrlich ascites solid tumor (EAT)-bearing mice. The parameters assessed included serum AST, ALT, ALP, total bilirubin, total protein and albumin.

Table 6: Effect on Liver Biochemical Parameters in EAT-Bearing Mice

Group	Treatment	AST (U/L)	ALT (U/L)	ALP (U/L)	Total Bilirubin (mg/dL)	Total Protein (g/dL)	Albumin (g/dL)
I	Normal control	72.46 $\pm$ 3.18	38.24 $\pm$ 2.14	118.52 $\pm$ 4.26	0.62 $\pm$ 0.05	6.82 $\pm$ 0.18	4.12 $\pm$ 0.12
II	EAT control	128.64 $\pm$ 5.42	76.38 $\pm$ 3.26	198.46 $\pm$ 6.18	1.42 $\pm$ 0.09	5.24 $\pm$ 0.21	2.86 $\pm$ 0.14
III	Vincristine + EAT	82.18 $\pm$ 3.74	45.62 $\pm$ 2.38	132.74 $\pm$ 4.52	0.74 $\pm$ 0.06	6.48 $\pm$ 0.19	3.86 $\pm$ 0.13
IV	Almond Oil + EAT	112.42 $\pm$ 4.86	66.18 $\pm$ 3.12	178.24 $\pm$ 5.64	1.22 $\pm$ 0.08	5.62 $\pm$ 0.20	3.18 $\pm$ 0.12
V	Almond Oil + EAT	94.36 $\pm$ 4.12	53.74 $\pm$ 2.76	151.62 $\pm$ 4.98	0.94 $\pm$ 0.07	6.12 $\pm$ 0.18	3.52 $\pm$ 0.11
VI	Eucalyptus Oil + EAT	108.28 $\pm$ 4.64	62.84 $\pm$ 2.94	171.36 $\pm$ 5.42	1.16 $\pm$ 0.08	5.76 $\pm$ 0.19	3.26 $\pm$ 0.12
VII	Eucalyptus Oil + EAT	88.54 $\pm$ 3.86	49.82 $\pm$ 2.52	141.28 $\pm$ 4.76	0.84 $\pm$ 0.06	6.32 $\pm$ 0.17	3.72 $\pm$ 0.12

Values are expressed as Mean $\pm$ SEM, n = 6

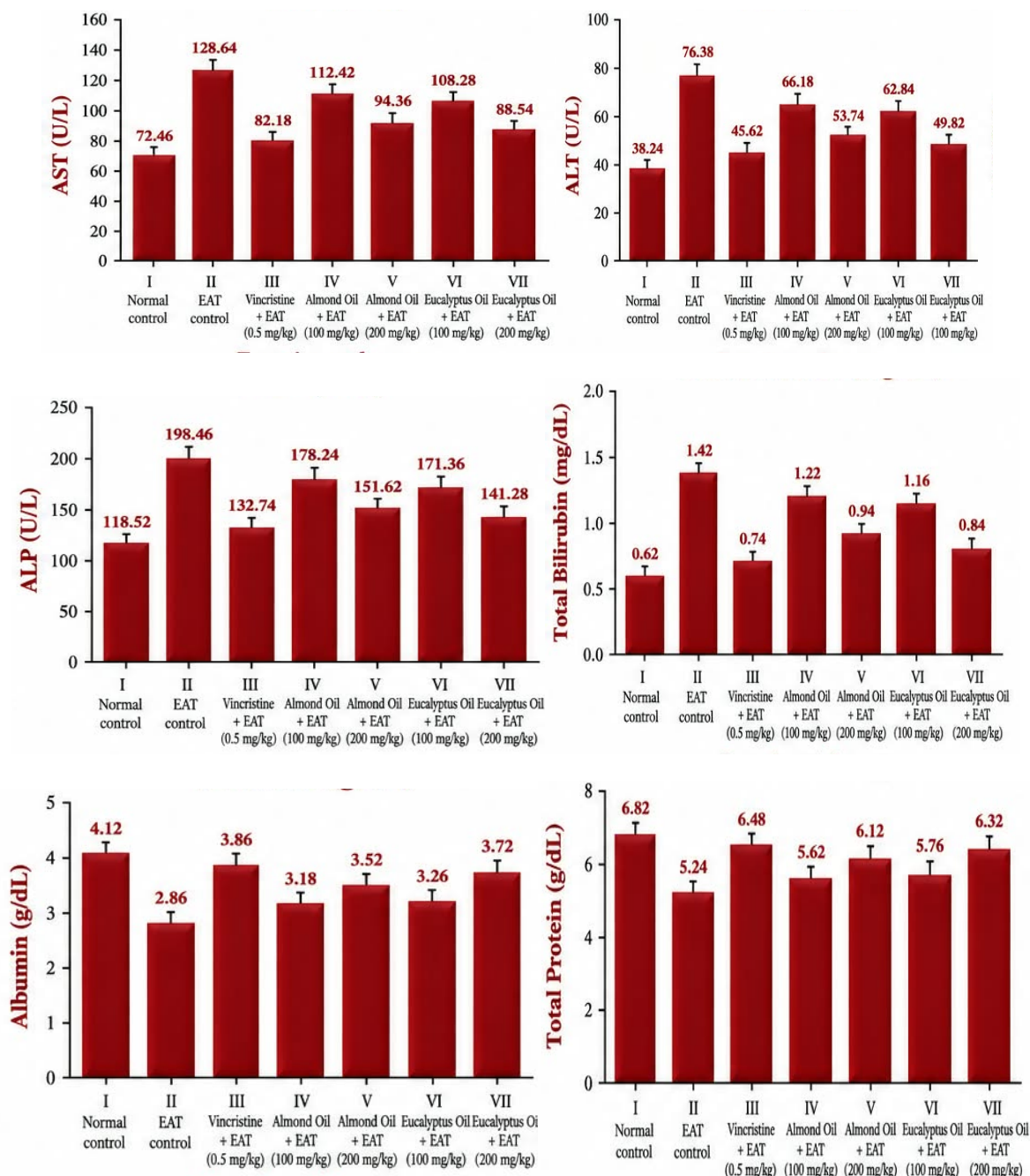


Figure 10: Effect on Liver Biochemical Parameters in EAT-Bearing Mice

The EAT control group exhibited marked elevation of AST, ALT, ALP and total bilirubin, with a reduction in total protein and albumin, indicating altered hepatic function associated with tumor progression.

Almond Oil and Eucalyptus Oil treatments improved these abnormalities in a dose-dependent manner.

The 200mg/kg doses were more effective than the respective 100mg/kg doses, with Eucalyptus Oil 200mg/kg showing comparatively greater normalization of the liver biochemical profile. Vincristine produced the strongest improvement among the treated groups.

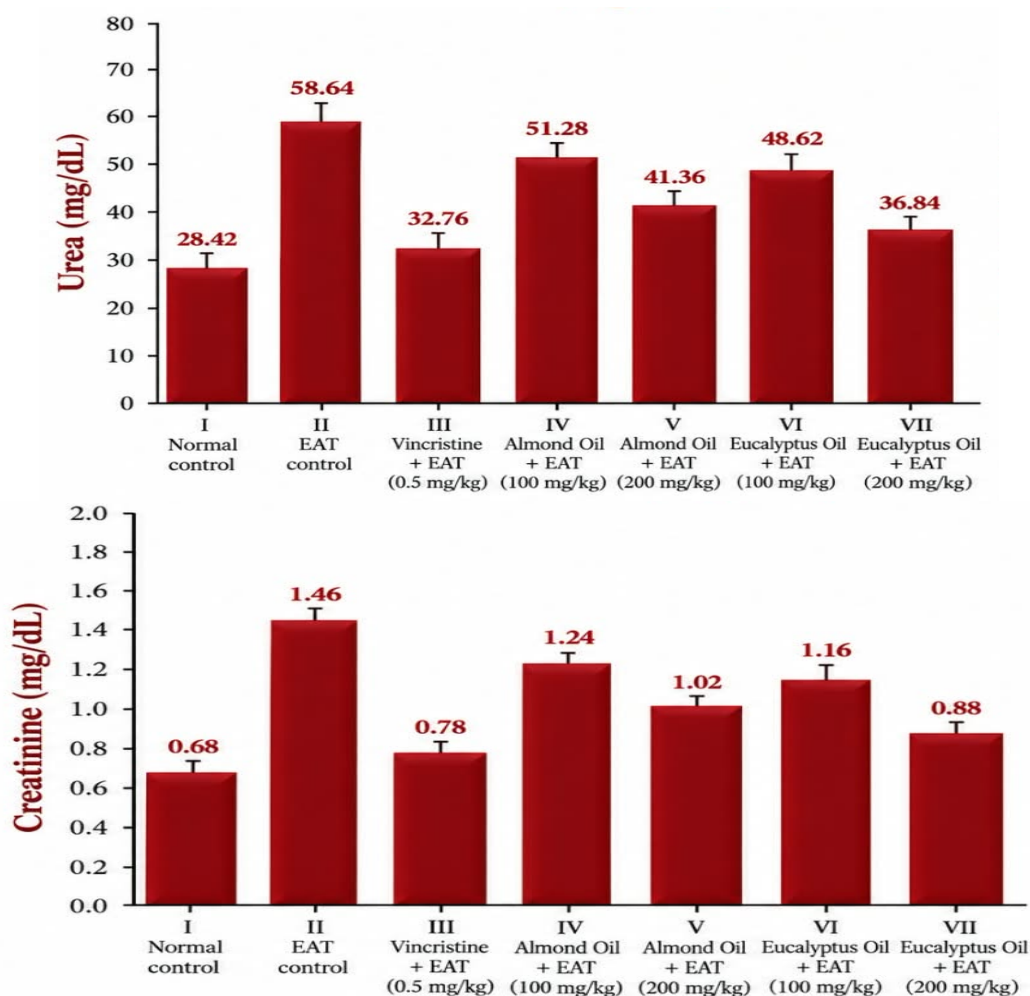
Kidney Biochemical Parameters: The effects of Almond Oil and Eucalyptus Oil on renal biochemical parameters were evaluated by estimating serum urea and creatinine levels in EAT-bearing mice. The EAT control group showed a marked increase in serum urea and creatinine compared with the normal control group, indicating impairment of renal function.

Treatment with Almond Oil and Eucalyptus Oil reduced these elevated levels in a dose-dependent manner. The 200 mg/kg doses produced greater improvement than the corresponding 100 mg/kg doses, while Vincristine produced the most pronounced normalization.

Table 7: Effect on Kidney Biochemical Parameters in EAT-Bearing Mice

Group	Treatment	Urea (mg/dL)	Creatinine (mg/dL)
I	Normal control	28.42 ± 1.36	0.68 ± 0.04
II	EAT control	58.64 ± 2.48	1.46 ± 0.08
III	Vincristine + EAT	32.76 ± 1.52	0.78 ± 0.05
IV	Almond Oil + EAT	51.28 ± 2.16	1.24 ± 0.07
V	Almond Oil + EAT	41.36 ± 1.84	1.02 ± 0.06
VI	Eucalyptus Oil + EAT	48.62 ± 2.04	1.16 ± 0.07
VII	Eucalyptus Oil + EAT	36.84 ± 1.68	0.88 ± 0.05

Values are expressed as Mean ± SEM, n = 6

**Figure 11: Effect on Kidney Biochemical Parameters in EAT-Bearing Mice**

The EAT control group showed elevated serum urea and creatinine levels compared with the normal control group, suggesting altered renal function during tumor progression.

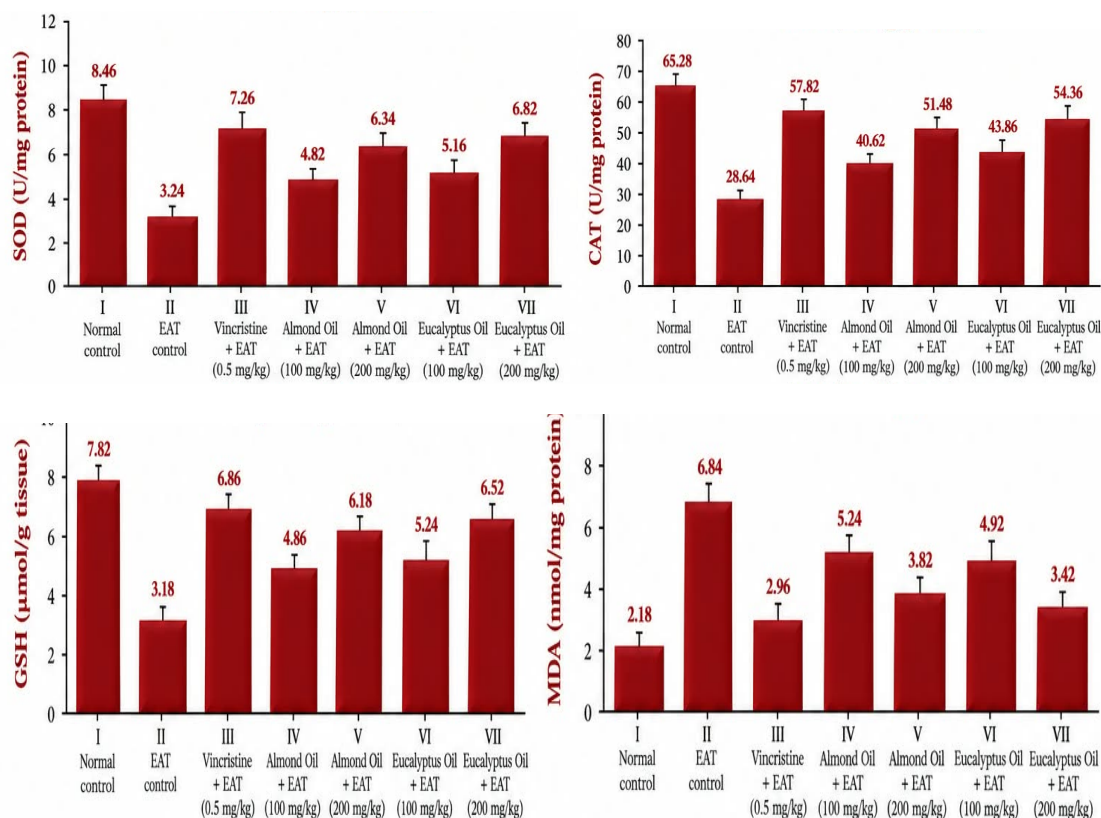
Treatment with Almond Oil and Eucalyptus Oil decreased both parameters in a dose-dependent manner. The 200 mg/kg doses were more effective than the respective 100 mg/kg doses, with Eucalyptus Oil 200 mg/kg showing comparatively greater improvement. Vincristine produced the greatest normalization of renal biochemical parameters.

Antioxidant Parameters: The antioxidant status of tumor tissue was evaluated by estimating Superoxide Dismutase (SOD), Catalase (CAT), Reduced Glutathione (GSH), and Malondialdehyde (MDA). The EAT control group showed a marked decrease in SOD, CAT and GSH levels with a concomitant increase in MDA compared with the normal control group. Treatment with Almond Oil and Eucalyptus Oil improved the antioxidant status in a dose-dependent manner. The 200 mg/kg doses produced greater improvement than the respective 100 mg/kg doses.

Table 8: Effect on Antioxidant Parameters in EAT-Bearing Mice

Group	Treatment	SOD (U/mg protein)	CAT (U/mg protein)	GSH ($\mu\text{mol/g}$ tissue)	MDA (nmol/mg protein)
I	Normal control	8.46 ± 0.32	65.28 ± 2.84	7.82 ± 0.36	2.18 ± 0.14
II	EAT control	3.24 ± 0.18	28.64 ± 1.76	3.18 ± 0.22	6.84 ± 0.32
III	Vincristine + EAT	7.26 ± 0.28	57.82 ± 2.46	6.86 ± 0.31	2.96 ± 0.18
IV	Almond Oil + EAT	4.82 ± 0.24	40.62 ± 2.12	4.86 ± 0.28	5.24 ± 0.26
V	Almond Oil + EAT	6.34 ± 0.26	51.48 ± 2.28	6.18 ± 0.30	3.82 ± 0.22
VI	Eucalyptus Oil + EAT	5.16 ± 0.23	43.86 ± 2.18	5.24 ± 0.27	4.92 ± 0.24
VII	Eucalyptus Oil + EAT	6.82 ± 0.29	54.36 ± 2.38	6.52 ± 0.32	3.42 ± 0.20

Values are expressed as Mean $\pm$ SEM, n = 6

**Figure 12: Effect on Antioxidant Parameters in EAT-Bearing Mice**

The EAT control group exhibited significant oxidative stress, characterized by reduced SOD, CAT and GSH levels and increased MDA concentration. Almond Oil and Eucalyptus Oil treatment progressively restored antioxidant enzyme activity and reduced lipid peroxidation. The 200mg/kg doses were more effective than the respective 100 mg/kg doses, with Eucalyptus Oil 200mg/kg showing comparatively better antioxidant protection.

Histopathological

Histopathological examination of tumor tissue was performed to assess the cellular and structural changes associated with Ehrlich solid tumor (EAT) development and to evaluate the protective effects of Almond Oil and Eucalyptus Oil. Tumor sections were stained with hematoxylin and eosin (H&E) and examined under a light microscope.

Examination:

Group I – Normal Control: The tumor tissue section of the normal control group showed normal cellular architecture with intact cells, uniform nuclei and well-preserved tissue organization.

No abnormal cellular proliferation, necrosis or degenerative changes were observed.

Group II – EAT Tumor Control: The EAT control group showed extensive and densely packed tumor-cell proliferation.

Marked cellular pleomorphism, hyperchromatic nuclei, increased mitotic activity and areas of cellular degeneration and necrosis were observed. These findings confirmed the establishment of Ehrlich solid tumor.

Group III – Vincristine + EAT (0.5mg/kg): The Vincristine-treated group demonstrated marked suppression of tumor-cell proliferation. Extensive

cellular degeneration, nuclear pyknosis and prominent areas of necrosis were observed, along with a considerable reduction in viable tumor cells and mitotic activity.

Group IV – Almond Oil + EAT (100mg/kg): The Almond Oil 100mg/kg group showed a moderate reduction in tumor-cell proliferation compared with the EAT control group. Mild-to-moderate cellular degeneration and focal necrotic areas were observed, indicating partial antitumor activity.

Group V – Almond Oil + EAT (200mg/kg): The Almond Oil 200mg/kg group exhibited greater histopathological improvement than the 100mg/kg group. There was a marked reduction in viable tumor cells, increased cellular degeneration and

necrosis, together with reduced cellular pleomorphism and mitotic activity.

Group VI – Eucalyptus Oil + EAT (100mg/kg): The Eucalyptus Oil 100mg/kg group showed mild-to-moderate suppression of tumor-cell proliferation. Cellular degeneration and focal necrosis were observed, with a reduction in tumor-cell density compared with the EAT control group.

Group VII – Eucalyptus Oil + EAT (200mg/kg): The Eucalyptus Oil 200mg/kg group showed pronounced histopathological improvement. Marked reduction in viable tumor cells, extensive cellular degeneration and necrosis, reduced pleomorphism and decreased mitotic activity were observed. The findings indicated stronger antitumor activity compared with the 100mg/kg dose.

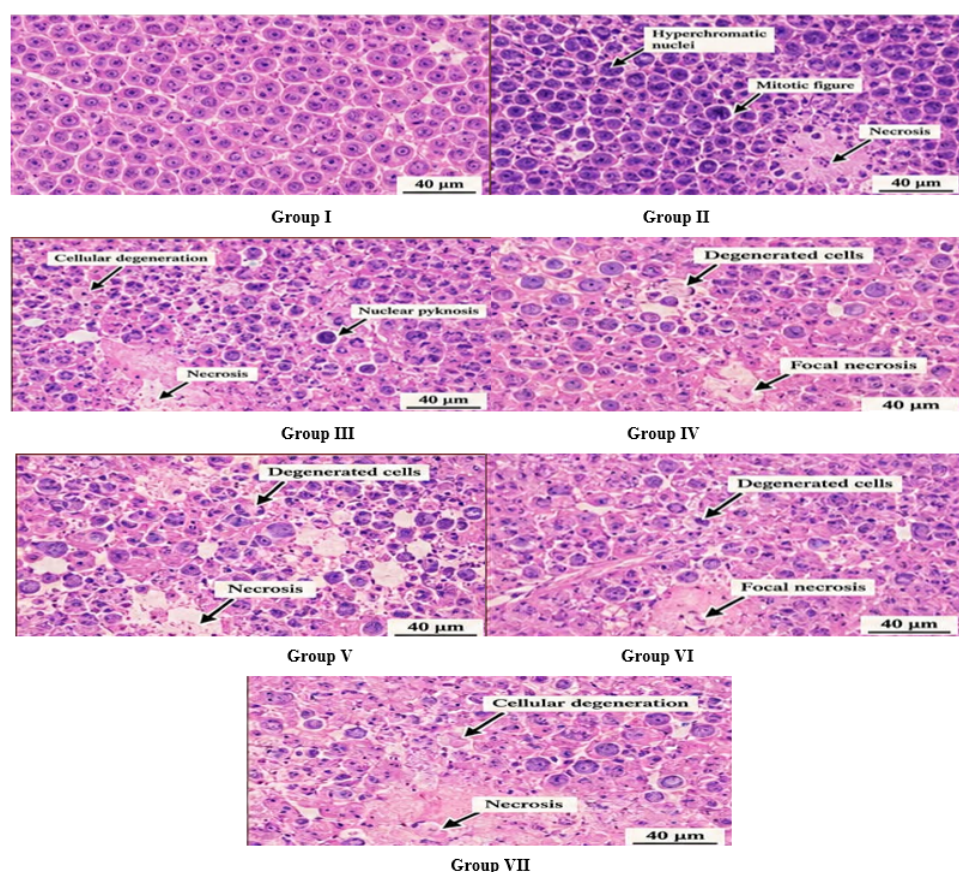


Figure 13: Microscopic Histopathological examination of Different Groups

Histopathological examination demonstrated severe tumor progression in the EAT control group, whereas Vincristine produced prominent tumor-cell degeneration and necrosis.

Both Almond Oil and Eucalyptus Oil produced dose-dependent histological improvement, with the 200mg/kg doses showing greater tumor-cell degeneration and necrosis than the respective 100mg/kg doses. Among the test groups, Eucalyptus Oil 200mg/kg showed comparatively

greater histopathological improvement, supporting its potential antitumor activity against EAT.

Discussion

The findings indicate that treatment with Almond Oil and Eucalyptus Oil attenuated tumor progression in Ehrlich solid tumor-bearing mice. The higher doses produced greater reductions in tumor burden than the lower doses. Eucalyptus Oil demonstrated a comparatively stronger response, particularly in reducing tumor volume and weight.

Changes in antioxidant and biochemical parameters further suggest a possible role in limiting tumor-associated oxidative stress. These observations support further investigation into the biological activities of both oils.

Conclusion

Almond Oil and Eucalyptus Oil demonstrated encouraging antitumor potential in the Ehrlich solid tumor mouse model. Among the tested oil treatments, Eucalyptus Oil at 200mg/kg showed the most promising response. The findings provide a basis for further research into their potential as sources of anticancer agents. Additional studies are necessary to establish their safety, mechanisms of action, and therapeutic relevance.

Summary

The present study evaluated the antitumor potential of Almond Oil and Eucalyptus Oil against Ehrlich solid tumor in mice. Both oils demonstrated dose-dependent reductions in tumor volume and tumor weight. Eucalyptus Oil at 200mg/kg showed comparatively greater activity than Almond Oil. Improvements in hematological, biochemical, and antioxidant parameters indicated potential protective effects. Further investigations are required to validate these findings and establish the safety and efficacy of both oils.

References

1. Kumar V, Abbas AK, Aster JC. Robbins and Cotran Pathologic Basis of Disease. 10th ed. Philadelphia: Elsevier; 2021.
2. Hanahan D, Weinberg RA. Hallmarks of cancer: The next generation. *Cell*. 2011;144(5):646–674.
3. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2021;71(3):209–249.
4. Moloney JN, Cotter TG. ROS signalling in the biology of cancer. *Semin Cell Dev Biol*. 2018;80:50–64.
5. Wong RS. Apoptosis in cancer: from pathogenesis to treatment. *J Exp Clin Cancer Res*. 2011;30:87.
6. Carmeliet P, Jain RK. Molecular mechanisms and clinical applications of angiogenesis. *Nature*. 2011;473(7347):298–307.
7. Bancroft JD, Gamble M. Theory and Practice of Histological Techniques. 7th ed. Philadelphia: Churchill Livingstone Elsevier; 2013.
8. Suvarna SK, Layton C, Bancroft JD. Bancroft's Theory and Practice of Histological Techniques. 8th ed. Philadelphia: Elsevier; 2019.
9. Burtis CA, Bruns DE, editors. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics. 8th ed. St. Louis: Elsevier; 2019.
10. Hoffbrand AV, Moss PAH. Hoffbrand's Essential Haematology. 8th ed. Hoboken: Wiley-Blackwell; 2019.
11. Dacie JV, Lewis SM. Dacie and Lewis Practical Haematology. 12th ed. London: Elsevier; 2017.
12. Motulsky H. Intuitive Biostatistics. 4th ed. New York: Oxford University Press; 2023.
13. Kim HY. Statistical notes for clinical researchers: one-way analysis of variance. *Restor Dent Endod*. 2017;42(4):261–266.