Research Article

ANTITUMOR AND *IN-VIVO* ANTIOXIDANT ACTIVITIES OF *PANDANUS ODORITISSIMUS* LINN. AGAINST EHRLICH ASCITES CARCINOMA IN SWISS ALBINO MICE

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ABSTRACT

Pandanus odoritissimus Linn. (Family Pandanaceae) has been indicated for various diseases one among which is used against cancer. The aim of the present study to evaluate the antitumor effect and antioxidant role of *Pandanus odoritissimus* whole plant in animal model. The Acetone fraction of *Pandanus odoritissimus* (AFPO) was administered at 200 and 400 mg/kg b.w. once a day for 14 days, after 24 hours of tumor inoculation. The effect of AFPO on the growth of tumor, life span of EAC bearing mice, hematological profile, liver biochemical Parameters (lipid Peroxidation, antioxidant enzymes) were estimated. AFPO decrease, the tumor volume, viable cell count and increasing the life span of EAC bearing mice and brought back the hematological Parameter more or less normal level. The effect of AFPO also decreased the levels of lipid Peroxidation and increased the levels of glutathione (GSH), Superoxide dismutase (SOD) and Catalase (CAT). The present study suggests that AFPO exhibited significant antitumor and antioxidant activities in EAC bearing mice.

Keywords: Antitumour activity, antioxidant activity, *Pandanus odoritissimus.*

INTRODUCTION

Ayurveda, the Indian system of medicine uses mainly plant based drugs or formulations to treat various ailments including cancer. Surveys suggest that one in three Americans uses dietary supplements daily and the rate of usage is much higher in cancer patients, which may be upto 50% of patients treated in cancer centres[1] chemotherapy is a major treatment for cancer and some of the plants like *Patophyllum Peltatum, Catharanthus roseus, Toxus brevifolia, Ochrosia ellipfica* and *Campototheca acuminate* have provided active principles which are in clinical use for controlling advanced stages of malignancies[2]. Natural products have been the mainstay of chemotherapy of cancer for the past 30 years. Most of them are obtained from plants or microorganisms, as the plant derived drugs, Vinblastine, Vincristine, Topatecan, etoposide, irinotecan, paclitaxel and other natural antibiotics, dactinomycin, bleomycin and doxorubicin are now in clinical use[3,4]. Oxygen free radicals are formed in tissue cells by many endogenous and exogenous causes such as metabolism, chemicals and ionizing radiation[5]. Oxygen free radicals may attack lipids and DNA giving rise to a large number of damaged products[6]. These radicals react with biological molecules such as DNA, Proteins, Phospholipids and eventually destroy the structure of other membranes & tissues[7,8]. Iron is known to be involved in the generation of reactive oxygen species (ROS) and in the formation of highly toxic hydroxyl radicals from other active oxygen species such as hydrogen peroxide[6,9,10]. The enhanced generation of ROS in vivo could be quite deleterious, since they are involved in mutagenesis, apoptosis, ageing and carcinogenesis[10]. Further activated oxygen species most likely play an important role in tumor promotion and progression[11]. For these reasons, the search for antioxidants as cancer chemo preventive agents is a continued process. Various epidemiological, experimental and metabolic studies have shown that nutrition plays an important causative role in the initiation, promotion and progression stages of several types of human cancers[12,13]. In addition to substances that pose cancer risk, the human diet also contains vegetables, fruits and beverages, which not only provide essential vitamins and minerals, but also include important chemo preventive agents capable of protecting against some forms of human cancer[12-14]. Many cancer chemo-preventive agents possess antioxidant potential[14].

The scientific community is interested in elucidating the role of several therapeutic, modalities, currently considered as elements of complementary and alternative medicine on the control of certain diseases. Plant derived natural products such as terpenoids & steroids etc have their diverse pharmacological properties including antioxidant and antitumor activity[15,16].

Based on traditional use this plant the present study was carried out to evaluate the antioxidant status and antitumor activity of acetone fraction of *P.Odoritissimus* against EAC bearing mice for the scientific validity.

Pandanus odoritissimus linn (Family-pandanaceae) a dioecious shrub densely branched with copious aerial roots found in the coastal region of India, including Andaman Nicobar Islands[17]. The shrub is well known under vernaculars as caldera bush in English, 'ketaki' in Oriya, 'Keora', in Hindi and 'Kaethakee' in Sanskrit[18-20]. The leaves of P. odoratissimus linn are used in traditional medicine to treat tumors, leprosy, smallpox, scabies,

leucoderma and blood diseases. Juice obtained from inflorescence from which the spathes have been removed used for rheumatic arthritis in veterinary medicine[18-21]. The shrub contains physcion, n-triacontanol, compestrol, cirsilineol, daucosterol, B-sitosteral, B-sitostenone, stigmasterol, stigmust-4-en-3, 6-dione[22,23]. The survey of literature reveals P. odoratissimus linn were used for tumor treatment for traditional system and some of the phytoconstituents were isolated from P. odoratissimus Linn. Because of the limited anticancer therapy, it is essential to continue for search for new anticancer agents. Hence an attempt is made to establish the scientific validity in order to investigate, the possible antitumor and invivo antioxidant effect of AFPO of P.odoratissimus Linn.

MATERIALS AND METHODS

Pandanus odoritissimus Linn. was collected rural belt of Mohuda, Berhampur, Orissa and was authenticated by comparing with herbarium specimen (POL-1) preserved in the museum of Biology Department, CPS, Mohuda, Berhampur.

Preparation of the Acetone Extract

The shade dried whole plant material was collected and was reduced to 60 mesh powder. The powder was extracted using soxhlet apparatus with Acetone and the yield was found to be 7.36gms/2.5litres. The extract was subjected to preliminary phytochemical screening[24] & finally confirmed through TLC. The extract at the doses of 200 and 400 mg/kg and 5-Flourouracil (20mg/kg) were used for the present study.

Animals used

Male swiss albino mice weighing between 18-22gm were used for the present study and were obtained from animal house, CPS, Mohuda, Maintained under standard environmental condition and were fed with standard pellet diet and water *ad libitum*. The Principles of Laboratory Animal care (NIH Publication no 85-23) guidelines[25]. The study was approved by the institutional Animal Ethical committee (Regd. No 1170/ac/08/CPCSEA).

Chemicals and reagents

Thiobarbituric Acid (Loba Chemie, Bombay, India) Chloro 2,4 dinitrobenzene [CDNB], 5,5 – Dithio-bis-2 nitrobenzoic acid [DTNB] Sisco research laboratory, Bombay. Nitroblue tetrazolium chloride [NBT] (Sigma, Chemicals USA) and other solvent and reagent. EAC cells were obtained from Chittaranjan National Cancer Institute (CNCI) Kolkata, India. The EAC cells were maintained by intraperitoneal inoculation of 2×10^6 cells/mouse.

Experimental protocol

Male swiss albino mice were divided into five groups of ten animals (n=10) each. The AFPO was dissolved in propylene glycol 5ml/kg b.w. and used directly for the experiment. EAC cells were collected from the donor mouse and were suspended in sterile isotonic saline. The viable EAC cells were counted (Trypan blue indicator) under the microscope and were adjusted at 2×10^6 cells/ml. Now 0.1ml of EAC cells per 10gm body weight of animals was injected (i/p) on day zero (d.o). A day of incubation (24h) was allowed for multiplication of the cells. Fourteen doses of the (AFPO 200 and 400mg/kg. EAC 0.1ml/10gm b.w.) and 5-fluorouracil 20mg/kg b.w. as standard[26] were injected intraperitoneally from the first day upto the 14th day with 24h time interval. Control animals received only vehicle (propylene glycol 5ml/kg). Food and water were with held 18h before sacrificing the animals. On day 15, half of the animals (n=5) from each cage were sacrificed and remaining animals kept for the observation of life span of the experimented animals as follows;.

So group I received propylene glycol 5ml/kg i/p once daily for 14 days.

Group II received EAC 0.1ml/10gm i/p

Group III received EAC 0.1ml/10gm i/p + 200mg/kg AFPO i/p

Group IV received EAC 0.1ml/10gm i/p + 400 mg/kg AFPO i/p

Group V received EAC 0.1ml/10gm i/p + 20mg/kg of 5 Fluorouracil.

Blood collected and hematological parameters were determined as determined in hematological studies. Liver and other important internal organs were removed, weighed and observed for pathological changes. Blood was centrifuged at 3000 rpm at 4^0C for 10 minutes to separate serum. The activities of SGOT (Serum Glutamate Oxaloacetate Transaminase level & SGPT (Serum Glutamate Pyruvate Transaminase)) were assyed[27]. The alkaline phosphatase activity in the serum was measured according to the method of king[28]. Liver biochemical parameters estimated by the methods described in estimation of biochemical parameters.

Tumor growth response

The antitumor effect of AFPO was assessed by change in the body weight, ascites tumor volume, packed cell volume, viable and nonviable tumor cell count, mean survival time (MST) and percentage increase in life span (% ILS). The mean survival time of each group of 5 mice was monitored by recording the mortality daily for 6 weeks and % ILS was calculated using equation[27,28].

$$MST = \frac{(Day\ of\ first\ death\ + Day\ of\ last\ death)}{2}$$

$$ILS\ \% = \left[\frac{Mean\ surveval\ time\ of\ treated\ group}{Mean\ survival\ time\ of\ control\ group} - 1\right] \times 100$$

Hematological parameters

Blood was obtained from the tail vein Hemoglobin[29] content, red blood cells[28] & white blood cells (W.B.C)[30] counts and differential leukocyte count[31] were estimated regarding the normal, EAC control and treated test and standard groups.

Biochemical parameters

The liver was excised rinsed in ice-cold normal saline, followed by cold 0.15M Tris-Hcl (PH 7.4), blotted and weighed. The homogenate was processed for estimation of lipid peroxidation, GSH, SOD and CAT. Assay for microsomal lipid peroxidation was carried out by the measurement of thiobarbituric acid reactive substances (TBARS) in the tissues[32]. The pinkchromogen produced by the reaction of malondialdehyde which is a secondary product of lipid peroxidation with thiobarbituric acid in 532 nm. Reduced glutathione (GSH) was assayed[33].

GSH estimation is based in the tissues on the development of yellow color when 5, 5^1-dithiobis (2-nitro benzoic acid) dinitro benzoic acid was added to compounds containing sulphydryl group. SOD was assayed[34]. The assay was based on the 50% inhibition of formation of NADH. Phenazineme-thiosulphate-Nitroblue tetrazolium formation at 520 nm. The activity of CAT was assayed[35]. Proteins were estimated[36] by using bovine serum albumin as the standard.

Acute toxicity studies/ maximum tolerated dose

The acute toxicity of AFPO was determined[37,38] and about $1/10^{th}$ of the LD_{50} dose has been considered for the anticancer activity.

Preliminary phytochemical investigation

Preliminary phytochemical analysis describes AFPO contains tannins and phenolic compounds in addition to steroids, triterpinoids and flavonoids.

Short Term Toxicity Studies

The AFPO was evaluated for it's short term toxicity in mice. The hematological profile and the biochemical parameters were shown in the table – 3(c). There was no harmful effect noticed either in liver or in kidney function in extract treated mice. However the mice received 400 mg/kg dose showed slight toxic symptoms. Such as loss of appetite, inactiveness, slow movement, dizziness, erection of hairs and hypothermia. Administration of repeated daily doses of 200mg/kg and 400mg/g for 14 days did not alter the body weight, and the weights of liver, kidney, brain and spleen. But the higher dose of AFPO 400 mg/kg/mouse/day were significantly altered the enzyme levels such as SGPT (56.6 ± IU/L) and SGOT (48.3±0.22 IU/L) when compared with that of the normal mice.

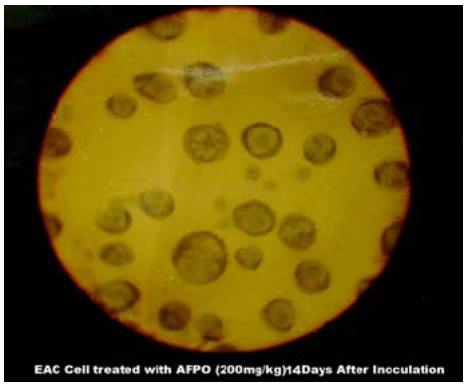

Table 1: Effect of the acetone extracts of *pandanus odoritissimus* linn. (AFPO) on survival time on EAC bearing mice.

Group	Experiment	Median survival days	Life span %	Increase of life span
1	Control prop. Glycol 5ml/kg b.w.	---	---	---
2	EAC control (2×10^6 cells) + propylene glycol 5ml/kg b.w.	20 ± 0.33	100	---
3	AFPO 200mg/kg/mouse/day + EAC (2×10^6 cells)	24 ± 0.28	120	20
4	AFPO 400mg/kg/mouse/day + EAC (2×10^6 cells)	30 ± 0.26	150	50
5	5-Flurouracil (20mg/kg/ mouse/day)+EAC(2×10^6cells)	41 ± 0.21	205	105

Experimental groups were compared with control values are mean ± SEM, No of mice in each group (n = 5) P< 0.05

Table 2: Effect of acetone extracts of *pandanus odoratissimus* linn. (AFPO) on tumor volume, packed cell volume, viable and nonviable tumor cell count of EAC bearing mice

Parameters	EAC control (2×10^6 cells/ mouse/ml)	AFPO 200mg/kg + EAC	AFPO 400mg/kg + EAC	Std 5-FU 20mg/kg + EAC
Body weight (g)	25.72±0.11	23.46±0.15	22.56±0.13	20.34±0.18
Tumor Volume (ml)	3.8±0.11	3.0±0.22	2.5±0.14	---
Packed cell volume (ml)	1.91±0.03	1.41±0.04	0.84±0.03	---
Viable tumor cell count × 10^7 cells/ml	9.6±0.23	3.1±0.18	2.8±0.14	---
Non-viable tumor cell count × 10^7 cells/ml	0.4±0.001	0.5±0.002	0.6±0.002	---

Experimental groups were compared with EAC control. Values are mean ± SEM, number of mice in each group (n = 5) P< 0.05.

Table 3: Effects of acetone extracts of *pandanus odoritissimus* linn. (AFPO) on hematological parameters of EAC treated mice.

Parameters	(Vehicle control) Propylene glycol 5ml/kg	EAC control (2×10^6cells)+Vehicle	EAC (2×10^6cells) +AFPO 200mg/kg	EAC (2×10^6cells) +AFPO 400mg/kg	EAC 2×10^6 cells + standard 5-flourouracil (20mg/kg b.w.)
Hemoglobin g%	13.2±0.23	9.4±0.33	11.2±0.24	11.8±0.34	12.0±0.55
Total RBC (cells/ml×10^9)	9.4±0.30	5.5±0.25	7.4±0.55	7.9±0.44	8.2±0.44
Total WBC (cells/ml×10^6)	11.2±0.32	23.0±0.23	21.1±0.76	19.0±0.62	14.5±0.61
cells/femur 1×10^6/ml)	18.5±0.34	14.5±0.26	16.7±0.38	17.5±0.11	17.2±0.45
Cells/spleen 2×10^6/ml	16.8±0.25	27.2±0.22	26.4±0.33	23.7±0.62	22.1±0.46
Spleen wt(mg)	124.1±1.1	204.2±0.80	175.4±0.62	170.1±1.0	140.2±0.62

Experimental groups were compared with EAC control. Values are mean ± SEM. Number of mice in each group (n = 5) P < 0.05.

Table 3(a): Effect of acetone extract of *pandanus odoritissimus* linn. *(AFPO)* on different counts of white blood cells in EAC bearing mice.

Design of Experiment	Lymphocyte %	Monocyte %	Neutrophil %	Eosinophil %
Propylene glycol 5ml/kg b.w.	71.4±0.25	2.1±0.01	26.6±0.26	0.6±0.02
EAC (2×10^6 cells) + propylene glycol 5ml/kg b.w.	33.5±0.55	1.4±0.03	63.3±0.56	1.6±0.04
EAC (2×10^6 cells)+AFPO 200mg/kg b.w.	43.6±0.48	1.1±0.03	41.4±0.40	0.6±0.03
EAC (2×10^6 cells) + AFPO 400mg/kg b.w.	59.8±0.52	1.2±0.06	36.9±0.30	0.6±0.02
EAC (2×10^6 cells) + standard drug (5-flurouracil 20mg/kg b.w.)	52.6±0.61	1.3±0.04	44.2±0.62	0.7±0.03

Experimental groups were compared with EAC control values are mean ± SEM (n = 5) P<0.05.

Table 3(b): Effect of different doses of acetone extract of *pandanus odoritissimus* linn. *(AFPO)* on different biochemical parameters in liver in EAC bearing mice.

Parameters	Propylene glycol 5ml/kg (vehicle)	EAC control (2×10^6cells) +Vehicle ml/kg b.w.	EAC (2×10^6cells) +AFPO 200mg/kg b.w	EAC (2×10^6cells) +AFPO 400mg/kg b.w.
Lipid peroxidation (n moles MDA/g of tissues)	0.97±0.02	1.46±0.03	1.33±0.02	1.20±0.01
GSH (mg/g of tissue)	2.37±0.03	1.68±0.11	2.15±0.14	2.28±0.03
SOD (units/mg protein)	4.37±0.23	3.28±0.21	3.72±0.11	4.21±0.01
Catalase (CAT) units/mg tissue	2.58±0.73	1.64±0.12	1.87±0.23	2.16±0.02

Experimental groups were compared with EAC control. Values are mean ± SEM (n = 5) P < 0.05.

Table 3(c): Short term toxicity effect of acetone extract of *pandanus odoritissimus* linn. *(AFPO)* on different biochemical parameters.

Parameters	Propylene glycol 5ml/kg	AFPO 200mg/kg	AFPO 400mg/kg
Hb (g%)	12.5±0.57	12.3±0.92	12.6±0.35
RBC (10^6)	9.4±0.35	9.2±0.40	9.6±0.30
WBC (10^3)	8.9±0.40	9.2±0.36	9.0±0.46
SGPT (U/L)	49.3±0.36	52.2±0.26	56.6±0.32
SGOT (U/L)	38.8±0.50	43.2±0.20	48.3±0.22
Serum urea (mg/dl)	21.6±0.76	22.6±0.50	22.7±0.41
Lipid peroxidation (n moles MDA/g of tissue)	0.96±0.02	0.97±0.03	0.97±0.02
GSH (mg/g of tissue)	2.35±0.03	2.38±0.10	2.53±0.03
SOD (units/mg of protein)	4.40±0.02	4.49±0.22	4.57±0.32
Catalase (units/mg tissue)	2.58±0.71	2.65±0.30	2.74±0.28

The experimental groups were compared with the normal groups by One way ANOVA Variations followed by Dunette's Test.. Values are mean ± SEM (n = 5) P < 0.01

RESULTS

The present investigation indicates that the AFPO showed significant antitumor and antioxidant activity in EAC bearing mice. The effects of AFPO (200 and 400mg/kg) at different doses on tumor volume viable and non-viable cell count, survival time and ILS were shown in Table 1 and in Table 2. Administration of AFPO reduces the tumor volume, packed cell volume and viable tumor cell count in a dose dependant manner when compared to EAC control mice. In EAC control mice the median survival time was 20 ± 0.33 days, where as it was significantly increased median survival time, (24 ± 0.28, 30 ± 0.26, 41 ± 0.21 days) with different doses (200 mg/kg and 400 mg/kg) of AFPO and standard drug 5FU(20mg/kg) respectively.

As shown in Table 3, the hemoglobin content in the EAC control mice (9.4±0.33 g% was significantly decreased when compared with normal mice 13.2±0.23 g%) AFPO at the dose of 200 and 400 mg/kg the hemoglobin content in the EAC treated mice were increased to (11.2±0.24)g%, (11.8±0.34)g%. There is a moderate, changes in the RBC count were observed in extract treated mice. The total WBC count was significantly higher in the EAC treated mice when compared with normal mice. Whereas AFPO treated mice significantly reduced the WBC counts as compared to that of the control mice, cells/femur was significantly reduced in EAC treated mice when compared with normal mice, where as AFPO treated mice significantly increased cells/femur in EAC treated mice while compared with normal mice.

In continuation, cells/spleen significantly increased in EAC treated group of mice while compared with the normal mice. Whereas AFPO treated mice significantly reduced cells/spleen while compared with that of the normal mice. Spleen weight was significantly higher in EAC treated mice when compared with normal mice. Where as AFPO treated mice significantly reduced the spleen weight while compared with that of the control mice. As shown in Table 3(a) the differential leukocyte count the percentage of neutrophils was increased while the lymphocyte count was decreased in the extract treated mice when compared with EAC control mice. The levels of LPO, GSH, SOD and CAT were summarized in table 3(b). The levels of lipid peroxidation in liver tissue were significantly increased in EAC control mice (1.46 nmoles MDA/g of tissue) as compared to the normal mice (0.97 n moles MDA/g of tissue). Treatment with AFPO (200 and 400 mg/kg b.w.) were significantly decreased the LPO levels (1.33 & 1.20 n moles MDA/g of tissue) in a dose dependant manner. The GSH content in the liver tissues of normal mice was found to be 2.37 mg/g of wet tissue. The EAC treated mice group decreased the GSH content to 1.68 mg/g of wet tissue. Whereas treatment with different doses of AFPO brought back the GSH level nearer to normal (2.15 & 2.28 respectively mg/g wet tissue) respectively. As shown in table 3(b), SOD level in the liver of EAC bearing mice was significantly decreased (3.28 units/mg protein) when compared with normal mice (4.37 units/mg protein). Administration of AFPO significantly increased SOD level (3.72 & 4.21 units/mg of protein in tissues) at the doses of 200, 400 mg/kg respectively. As shown in Table 3(b) CAT level were decreased in EAC control mice (1.64 units/mg of protein in tissue) when compared with normal mice (2.58 units/mg of protein in tissue) treatment with AFPO at the doses of 200 & 400 mg/kg b.w. brought back the CAT level nearer to normal levels 1.87 and 2.16 (units/mg of protein in tissues).

DISCUSSION

This study carried out in order to evaluate the effect of AFPO on EAC bearing mice. The AFPO showed significant antitumor activity against transplantable tumor. The most reliable criteria for judging the value of any anticancer drug is the prolongation of life span of experimented animals[39]. The ascetic fluid is the nutritional source to tumor cells and rapid increase in ascetic fluid with tumor growth could be possibly by means to meet more nutritional requirements of tumor cells[40]. The reduction in the number of ascetic tumor cells may indicate either an effect of AFPO on peritoneal macrophages or other components of the immune system[41]. So, therefore increasing their capacity of killing the tumor cells or having a direct effect on tumor cell growth. Acetone fraction of *P. odoratissimus* (AFPO) inhibited significantly the tumor volume, viable cell count, packed cell volume and enhancement in survival time of EAC bearing mice and therefore acts as antitumor agent.

With comparison to EAC control animals, AFPO treatment and subsequent tumor inhibition resulted in satisfactory improvements in hemoglobin content, RBC count and WBC count (Table-3). From the above observations it has been concluded that anemia is the common complication in cancer and the situation further aggravates during chemotherapy as a majority of antineoplastic agents exerts suppressive effect on erythropoiesis[42,43] and thereby limiting the uses of these drugs. The anemia encountered in tumor bearing mice is mainly due to reduction in RBC or hemoglobin percentage and this may occur either due to iron deficiency or due to hemolytic or myelopathic conditions[44]. The improvement in the hematological profile of the tumor bearing mice with AFPO could be due to the action of different phytoconstituents present in the extract.

Malor dialdehyde (MDA) is formed during oxidative degeneration as a product of free oxygen radicals[45], which is accepted as an indicator of lipid peroxidation[46]. MDA, the end product of lipid peroxidation was reported to be higher in cancer tissues than in non-diseased organ[47]. Our results indicate that TBARS levels in the tested cancerous tissues are higher than those of in normal tissues.[48,49].

Glutathione a potent inhibitor of neoplastic process, plays an important role in the endogenous antioxidant system. It is found in high concentration in the liver and plays a key role in the protective process. Excessive production of free radicals resulted is oxidative stress, which leads to

damage to macromolecules e.g. Lipid peroxidation *in vivo*[50] GSH can act either to detoxify activated oxygen species such as H_2O_2 or reduce lipid peroxides themselves. In our present study AFPO significantly reduced the elevated levels of lipid peroxidation and increased the levels of glutathione content and thereby it may act as an antitumor agent.

SOD is a ubiquitous chain breaking antioxidant found in all aerobic organisms. It is present in all cells and plays an important role against ROS-induced oxidative damage. The free radical scavenging system catalase which are present in all major organs in the body of animals and human beings and are concentrated generally in liver and erythrocytes. Both enzymes play on important role in the elimination of ROS derived from the redox process of xenobiotics in liver tissues[51,52]. It has been suggested that catalase and SOD are easily inactivated by lipid peroxides or ROS[53]. From the experiment it has been found that EAC bearing mice showed decreased levels of SOD activity and this may be due to loss of Mn^{++} SOD activity in liver[54]. Inhibition of catalase activity in tumor cell lines was also reported[55]. In the present study SOD and catalase were elevated appreciably by administration of AFPO, further gives indication that it can restore the levels of catalase and SOD enzymes.

The administration of AFPO at two different doses significantly increased the SOD and CAT levels in a dose dependent manner. It was reported that plant-derived extracts containing antioxidant principles showed cytotoxicity towards tumor cells[56] and antitumor activity in experimental animals[57]. Antitumor activity of these antioxidants is either through induction of apoptosis[58] or by inhibition of neovascularization[59]. The implication of the radicals in tumors is already published[60, 61]. The free radical theory defines the fact that the antioxidants effectively inhibit the tumor cell. Hence, AFPO contains antioxidant as well as anticancer active principles.

CONCLUSION

Present study demonstrated that AFPO increased the life span of EAC bearing mice and decreased lipid per oxidation and thereby augmented the endogenous antioxidant enzymes in the liver. All these parameters suggest that AFPO posses very significant antitumor and antioxidant activities.

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