IAMJ

Research Article *International Ayurvedic Medical Journal* *ISSN:2320 5091*

EVALUATION OF THE ANTITUMOR ACTIVITY OF AYURVEDIC FORMULATION *KANCHANARA GUGGULU* ON N-METHYL-N-NITROSOUREA (NMU) INDUCED MAMMARY TUMOR IN SPRAGUE-DAWLEY RATS

RakeshA[1], Remya A[2], Divya Ravindran[3]

[1]Clinical Pharmacist (M-Pharm),[2] PG Scholar, [3]PG Scholar

Dept. of P.G studies in *Rasashastra and BhaishajyaKalpana*, Amrita School of Ayurveda, Kollam, Kerala, India

ABSTRACT

Tumor is a major health problem all over the world. In India the incidence of mammary tumor (Breast cancer) is on the rise and it has become the number one cancer in females. Although many drugs are available for the treatment of mammary tumor, the results are often unsatisfactory due to many adverse effects. Many researches are going on to bring new drugs for the treatment of tumors.Tumors can be correlated with *Arbuda* in Ayurveda and there are a number of Ayurvedic formulations mentioned in the treatment of *Arbuda.* Hence this study was aimed to investigate the anti-tumor effect of *Kanchanara Guggulu* on NMU (N-methyl-N-nitrosourea) induced mammary tumor in rats. The present study showed that the treatment with *Kanchanara Guggulu* on NMU induced mammary tumor in rats produced significant increase in TCA cycle enzymes, reversed the altered Haematological and Biochemical parameters towards near normal level when compared to NMU control rats. It clearly indicates the antitumor activity of *Kanchanara Guggulu* and its efficacy similar to that of the standard drug Tamoxifen (TA).

Key words: Tumors, *Arbuda, Kanchanara Guggulu*.

INTRODUCTION

Cancer is a major health problem all over the world. Cancer is a term indicating the proliferation of cells, which is no longer under the control of the organism[1].These extra cells lump together to form a tumor.Tumors can be correlated with *Granthi* or *Arbuda* in Ayurveda and there are a number of Ayurvedic formulations mentioned in the treatment of *Arbuda*[2-3].Breast cancer is one of the dreadful diseases and it is the leading cause of death among the women population. The rate of rise of breast cancer in Indiais so rampant, that if do not act now, itwillbecome a major shock in the next twenty years[4]. Although many drugs are present for the treatment of breast cancer, they possess many side effects such asbone marrow depression, secondary tumor conditions etc[5-7]. Due to this reason, many researchers are working to bring new drugs from all possible sources which include traditional medicinal system also. Ayurveda, the traditional Indian medicine of plant drugs has been successful from very early times in using these natural drugs and preventing or suppressing various tumors using various lines of treatment[8].

FORMULATION PROFILE[9-10]

Table No 1: Showingthe list of ingredients present in the KG formulation

Sl.No.	Sanskrit name	Botanical name	Indications	Reference
1	*Kanchanaratwak*	Bauhinia variegata	*Gandamala Apachi Arbuda Granthi Vrana Gulma Kushta Bhagandara*	Ayurvedic Formulary of India, Part -1. or *SharngdharaSamhita – MadhyamaKhanda*
2	*Amalaki*	Emblicaofficinalis		
3	*Haritaki*	Terminaliachebula		
4	*Vibhitaki*	Terminaliabellerica		
5	*Nagara*	Zingiberofficinalis		
6	*Maricha*	Piper nigrum		
7	*Pippali*	Piper longum		
8	*Varuna*	Crataevareligiosa		
9	*Twak*	Cinnamomumzeylanicum		
10	*Ela*	Elettariacardamomum		
11	*Patra*	Cinnamomumtamala		
12	*Guggulu*	Commiphoramukul		

MATERIALS AND METHODS

1. **Procurement of *Kanchanara Guggulu*(*KG*):** *Kanchanara Guggulu* was procured from SNA Oushadhashala, Kerala, which was prepared as per AFI.
2. **Preliminary Phytochemical Analysis of *Kanchanara Guggulu*[11].**
3. **Treatment Protocol:**

➢ **Antitumor activity:**

A. **Haematological Evaluation**: through estimation of RBC, WBC and Hb.

B. **Estimation of Serum Biochemical Parameters:** like ALP, SGOT, SGPT and Serum Creatinine out of which ALP is considered as the tumor marker in this study.

➢ **Antioxidant activity:**

A. **In-vitro Antioxidant Activity:** through DPPH & ABTS radical scavenging activityand Ferric Reducing Antioxidant Power (FRAP).

B. **In-vivo Antioxidant Activity:** through estimation of Catalase, Superoxide dismutase (SOD), Reduced glutathione (GSH), Glutathione peroxidase (GPx) and Lipid Peroxidase (LPx) activity.

C. **Estimation of Mitochondrial TCA Cycle Enzymes:**throughthe assay of Isocitrate Dehydrogenase(ICD), α-Ketoglutarate Dehydrogenase (KGD), Succinate Dehydroganase (SD) and Malate Dehydrogenase (MD)[12].

SELECTION OF ANIMALS FOR THE STUDY

The animals used for the study were procured from the ‘’Government Veterinary college’’, Thrissur, Kerala, after approval from the IAEC (Institutional Animal Ethical Committee).

Species	: Sprague dawley rats
Age	: 50 days
Body weight	: 100-120gm
Gender	: Female
No. of animals	: 42

Preparation of NMU

The NMU was purchased from Sigma chemicals, Mumbai, India and was stored according to the manufacturer label (2-8˚C) to prevent its decomposition. NMU was dissolved immediately prior to its use in 0.9% NaCl solution acidified to pH 5.0 with acetic acid. A satisfactory working concentration is 14 mg NMU per ml.

Induction of cancer

- **Carcinogen** : N-methyl-N-nitrosourea (NMU)
- **Dose** : 50mg/kg
- **Solvent** : 0.9% Sodium chloride
- **Route of administration** : Intra peritonial (i.p)

Experimental design

Experimental rats were divided into 7 groups of 6 animals each and received the following treatment on 0 to 60th day. Details are shown below in the Table No: 2.

Table No 2: Showing the Experimental design.

GROUPS	NAME	TREATMENT	DOSE
I	Control	0.5% CMC (Carboxy Methyl Cellulose)	0.5 ml
II	Negative control	NMU control	50 mg/kg
III	Standard	NMU+TA (Tamoxifen)	10 mg/kg
IV	Treatment I	NMU+KG(*KanchanaraGuggulu*)	125 mg/kg
V	Treatment II	NMU+KG (*KanchanaraGuggulu*)	250 mg/kg
VI	Treatment III	NMU+ KG (*KanchanaraGuggulu*)	500 mg/kg
VII	Treatment IV	NMU+KG (*KanchanaraGuggulu*)	1000 mg/kg

RESULTS AND OBSERVATION

PRELIMINARY PHYTOCHEMICAL ANALYSIS

The preliminary phytochemical studies of *KanchanaraGuggulu*, confirmed the presence of constituents such as Flavonoids, Steroids, Sterols, Carbohydrates, Alkaloids, Glycosides, Saponins, Phenolic Compounds, Tannins, Proteins and Amino Acids. The details are given in Table No: 3.

ESTIMATION OF HEMATOLOGICAL PARAMETERS

NMU control group animals showed significant ($P < 0.001$) decreased levels of RBC, Hb and significant ($P < 0.001$) increased levels of WBC compared to normal control group. The groups administered with KG (125, 250, 500 and 1000 mg/kg)and TA(10 mg/kg)showed significant($P < 0.001$)increase in RBC, Hb and

significant (P < 0.001)decrease in WBC. The details are given in Table No: 4.

ESTIMATION OF SERUM BIOCHEMICAL PARAMETERS

The parameters include ALP, SGOT, SGPT and Serum Creatinine and out of which ALP is considered as the tumor marker in this study. A significant increased serum ALP levels was observed in the NMU control rats when compared to normal control rats. Rats treated with KG showed significantly lower ALP levels when compared with NMU control rats.The details are given inTable No: 5.

ESTIMATION OF IN-VIVO ANTIOXIDANT LEVELS

In NMU control rats, significant decreased levels of SOD, Catalase, GSH and GPx were observed as compared to normal control rats. But the KG and TA treated groups showed significant increase in the levels when compared to NMU control rats. NMU control rats showed significant increased LPx levels when compared to normal control rats. The KG and TA treated rats showed significant decreased LPx levels when compared to NMU control rats. The details are given in table No: 6&7.

ESTIMATION OF MITOCHONDRIAL TCA-CYCLE ENZYMES

A significant (P < 0.001) decreased levels of ICD, KGD, SD and MD was observed in NMU control rats after the i.p administration of NMU when compared to normal control rats. Rats treated with KG 125, 250, 500 and 1000 mg/kg showed significantly higher (P<0.001) levels of ICD, KGD, SD and MD, when compared to NMU control rats. Rats treated with TA 10 mg/kg showed significantly higher (P<0.001) levels of ICD, KGD, SD and MD compared to NMU control rats. The details are given in table No: 8.

DISCUSSION

The treatment of mammary tumor has made substantial improvements since the early years of modern antitumor drug research.The identification and development of natural compounds and their derivatives have greatly contributed in the field of antitumor drug research due to its inhibitory role on specific processes involved in the carcinogenesis. Mammary tumor is associated with multiple genetic alterations which lead to the fundamental changes in the vital metabolic pathways such as TCA-cycle and glycolytic pathway, which in turn enhance lipid peroxidation and liberates free radicals. The present study was aimed to assess the efficacy of the Ayurvedic formulation *KanchanaraGuggulu* (KG)for its antitumor activity in NMU induced rat mammary tumor. The NMU induced mammary tumor is one of the chemically induced mammary carcinoma model which can be used to evaluate anticancer property of drugs. In this study, administration of NMU to the female Sprague Dawley rats produced significant mammary tumor compared to normal control rats. The intra-peritoneal administration of NMU to the rats showed significant decrease in the body weight when compared to normal control rats. In the case of treatment groups after the administration of KG at different doses showed considerable prevention of weight loss when compared to NMU control rats.

In-vivo antioxidants

Living organisms have developed several effective mechanisms to get protection from the reactive oxygen species. The antioxidant defense mechanisms of the body include enzymes such as Superoxide dismutase (SOD), Catalase, Reduced glutathione (GSH) and Glutathione Peroxidase (GPx). The cells containing SOD scavenges superoxide ion and prevents its accumulation, so that cells are protected from oxidative stress. The Catalase

enzyme is an endogenous antioxidant enzyme that neutralizes reactive oxygen species by converting H_2O_2 into H_2O and O_2. GSH prevents free radical induced oxidation of SH groups of various proteins to disulfide derivatives. It also protects Haemoglobin from getting oxidized by H_2O_2. The biochemical function of GPx involves the reduction of lipid hydroperoxides to their alcohols and to reduce free hydrogen peroxide to water. Thus it protects the cell from oxidative damage. The NMU control rats showed significant lower GPx levels when compared to normal control rats. The KG and TA treated rats showed significant higher GPx levels when compared to NMU control rats.Lipid peroxidation (LPx) indicates the oxidative degradation of lipids in which the free radicals steal electrons from the lipids in the cell membrane and leads to cell damage. This process proceeds by a free radical chain reaction mechanism. A significant increased level of LPx was observed in the NMU control rats when compared to normal control rats. The KG and TA treated rats showed significant decreased LPx levels when compared to NMU control rats.

Mitochondrial TCA-cycle enzymes

Mitochondria play a critical role in bioenergetics, anabolism and cell death, which ranges from high tissue-specific conditions to generalized whole-body disorders including Cancer. Several common features of established tumor cells can directly or indirectly result from mitochondrial deregulation. Mitochondria may be implicated in early stages of tumor genesis. The TCA cycle enzymes such as Isocitrate dehydrogenase (ICD), α-Ketoglutarate dehydrogenase (KGD), Succinate dehydrogenase (SD) and Malate dehydrogenase (MD) were performed and the NMU control rats showed significant decreased levels when compared to normal control rats. After treatment with KG and TA there was a significant increase in the levels of enzymes when compared to NMU control rats.

Probable Mode of Action of Individual Ingredients

***KachanaraTwak*:** The bark is astringent and general tonic. It is useful in skin diseases, ulcers, leprosy, diarrhoea, dysentery and hemorrhoids[13-14].

***Guggulu*:** It is astringent, anti-inflammatory and antiseptic. When taken internally it acts as a stomachic and carminative, stimulating the appetite and improving digestion. It causes an increase in leucocytes in the blood and stimulates phagocytosis. It acts as a diaphoretic, expectorant and diureticand is said to be a uterine stimulant[15].

Nagara: It is aromatic, carminative, stimulant to the gastro-intestinal tract, stomachic and digestive. It contains Camphene, Phellandrene, Zingiberine, Cineol, Borneol, Gingerol, an oleo-resin Gingerin, other resins, starch and potassium-oxalate. Ginger is extremely valuable in dyspepsia, flatulence, colic, vomiting, spasms and other painful affection of the stomach[16-17].

Pippali: It is an alternative tonic, appetizer & carminative agent. It is known to help in general debility, dyspepsia, flatulence & respiratory tract infection[18].

Maricha: It acts as a stomachic in dyspepsia and flatulence. It has bacteriostatic and fungistatic properties.

Haritaki: It is a general & nervine tonic as well as carminative & liver stimulant. It is known to help in nervine debility, hepatic disorders & constipation.

Vibhitaki: A stringent, tonic, expectorant and laxative. Fruits are useful in cough, hoarseness of voice, eye disease and scorpion sting. It consists of tannic acid, resins etc.

Amalaki: Fresh fruit is refrigerant, diuretic and laxative. Dried fruit is sour and astringent and useful in hemorrhage, diarrhoea and dy-

sentery; with iron it is a valuable remedy in anaemia, jaundice and dyspepsia. The fresh fruit contains very high percentage of vitamin C and is effective in infection of the lungs and throat, chronic bronchitis, whooping cough and asthma[19].

Varuna: It has anti-inflammatory, diuretic, demulcent and tonic properties. Bark yields Cerylalcohol, Friedelin, Lupeol, Betulinic acid and Diosgenin. It is useful in disorders of urinary organs, urinary tract infections, pain and burning micturition, renal and bladder calculi[20].

Twak: It is useful for soothing problems of the stomach, urinary tract and diabetes. It has antimicrobial, anti-parasitic, anti-oxidant and free radical scavenging properties. In addition it seems to lower blood glucose, serum cholesterol and blood pressure, suggesting beneficial cardiovascular effects[21].

Ela:It is carminative, appetizer, cardiac and general tonic. It is known to help in general debility, cardiac disorders, anorexia & flatulence.

Patra: It is a nervine tonic, digestive, carminative, uterine stimulant & appetizer. It is known to help in general debility, uterine disorders, anorexia & indigestion[22].

Phyto-Chemical components & their Anti-tumor effects

The phytochemical studies of the ingredients of *KanchanaraGuggulu* (KG), confirmed the presence of constituents such as flavonoids, steroids, alkaloids and glycosides. Flavonoids exhibit wide range of biological effects and one of the important effects are the scavenging of oxygen derived free radicals. Flavonoids have the capacity to act as antioxidants. The flavones and catechins seem to be the most powerful flavonoids for protecting the body against reactive oxygen species. The free radicals and reactive oxygen species will causes damage to the cells and tissues, which are produced during normal oxygen metabolism. One of the most important mechanism seems to be lipid peroxidation, which results in cellular membrane damage. Reactive oxygen species can damage DNA, and further division of cells with unrepaired or damage leads to mutations. If these changes appear in oncogenes or tumor suppressor genes, may results in the initiation or progression. Reactive oxygen species can interfere directly with cell signaling and growth. The cellular damage caused by reactive oxygen species can induce mitosis and that DNA will lead to mutations, and can increase the exposure of DNA to mutagens.

CONCLUSION

The present study showed that, the treatment with *Kanchanaraguggulu* (KG) on NMU induced tumor rats produced significant increase in TCA cycle enzymes, reversed the altered Haematological (WBC, RBC and Hb) and Biochemical (ALP) parameters towards near normal level compared to NMU control rats. It clearly indicates the antitumor activity of *KanchanaraGuggulu* and its efficacy similar to that of standard drug Tamoxifen. Moreover, the *KanchanaraGuggulu* (KG) exhibited significant antioxidant activity and it will help to prevent progression of Cancer. The antitumor and antioxidant activity of KG may be due to presence of flavonoids, phenolic compounds, steroids and alkaloids.Therefore, based on the above results, it can be concluded that, *kanchanaraGuggulu* possess significant antitumor activity in NMU induced mammary tumor in rats and it clearly supports the usage of the same for the treatment of Cancer in humans.

Scope for further research

Clinical trials can be conducted to find out the effect of *KanchanaraGuggulu* on mammary tumor.

Table No3: Showing the Phytochemical Analysis of *KanchanaraGuggulu*(KG)

S.No.	Phytochemical constituents	KG methanol extract
1.	Flavonoids	+ve
2.	Steroids and Sterols	+ve
3.	Carbohydrates	+ve
4.	Alkaloids	+ve
5.	Glycosides	+ve
6.	Saponins	+ve
7.	Tannins	+ve
8.	Phenolic compounds	+ve
9.	Proteins and amino acids	+ve
10.	Terpenoids	+ve

Table No4: Showing the Estimation of Haematological Parameters

Group	Dose (mg/kg)	WBC ($1x10^9$/L)	RBC ($1x10^{12}$/L)	Hb (%)
Control	Vehicle (5ml/kg)	7.60 ± 0.07	7.62 ± 0.12	11.73 ± 0.87
NMU control	Vehicle (5 ml/kg)	11.39 ± 1.0	4.43 ± 0.12	7.93 ± 0.48
NMU + TA	10	7.72 ± 1.44	6.7 ± 0.14	11.13 ± 0.06
NMU + KG	125	11.17 ± 1.09	4.92 ± 0.03	8.26 ± 0.17
NMU + KG	250	10.46 ± 1.05	5.12 ± 0.06	8.00 ± 0.57
NMU + KG	500	9.60 ± 1.25	5.27 ± 0.37	10.01 ± 0.57
NMU + KG	1000	8.08 ± 1.09	6.12 ± 0.06	11.04 ± 0.047

All values are expressed as mean ± SEM (n=6).

Table No5:Showing the Estimation of Serum Biochemical Parameters

Group	Dose (mg/kg)	Creatinine (mg/dl)	SGOT (U/l)	SGPT (U/l)	ALP (U/l)
Control	Vehicle (5 ml/kg)	0.46±0.03	139.37±1.26	70.66±1.34	126 ±1.35
NMU control	Vehicle (5ml/kg)	0.51±0.17	137.43±1.49	77.00±1.52	177.33 ±1.76
NMU + TA	10	0.46±0.10	131.66±1.60	72.33±1.32	143.23 ±1.88
NMU + KG	125	0.43±0.03	126.73±0.83	77.33±1.02	160.28 ±1.85
NMU + KG	250	0.40±0.73	126.66±0.17	75.66±1.17	153.66 ±1.40
NMU + KG	500	0.43±0.73	126.33±0.13	72.66±1.13	154.74 ±1.15
NMU + KG	1000	0.45±0.03	127.33±0.14	76.33±1.66	145.33 ±1.18

All values are expressed as mean ± SEM (n=6).

Table No 6: Showing the Estimation of In-Vivo Antioxidant Levels in Liver.

Group	Dose (mg/kg)	TBARS (MDAformed/ mg protein)	SOD (Unit/min/ mg protein)	Catalase (µmol of H2O2 consumed/min/mg protein)	GSH (GSH g/mg pro-tein)	GPX (GSH oxidized g/mg pro-tein)
Control	Vehicle(5 ml/kg)	0.17±0.02	25.26±3.18	9.81±1.70	2.42±0.23	1.63±0.12
NMU con-trol	Vehicle(5 ml/kg)	0.88±0.00	2.65±1.02	4.08±0.36	0.31±0.01	0.13±0.10
NMU + TA	10	0.26±0.11	19.86±1.35	9.68±0.11	2.11±0.48	1.15±0.21
NMU + KG	125	0.80±0.02	3.17±1.61	4.18±0.47	0.61±0.04	0.29±0.01
NMU + KG	250	0.71±0.04	3.56±0.87	4.47±0.67	0.81±0.04	0.42±0.15
NMU + KG	500	0.69±0.06	12.67±0.33	7.62±0.08	1.31±0.08	0.35±0.03
NMU + KG	1000	0.41±0.01	15.17±4.66	8.57±0.07	1.47±0.17	0.88±0.19

All values are expressed as mean ± SEM (n=6).

Tabl No:7Showing the Estimation of In-Vivo Antioxidant Levels in Kidney.

Group	**Dose (mg/kg)**	**TBARS (MDA formed/ mg protein)**	**SOD (U/mg protein)**	**Catalase (µmol/mg)**	**GSH (GSH g/mg protein)**	**GPX (GSH oxi-dized g/mg protein)**
Control	Vehicle(5ml/kg)	0.20±0.04	0.91±0.02	12.37±0.43	0.94±0.02	3.145±0.428
NMU con-trol	Vehicle(5ml/kg)	0.87±0.01	0.26±0.03	4.33±0.06	0.20±0.07	0.271±0.021
NMU + TA	10	0.38±0.04	0.74±0.05	8.46±0.17	0.92±0.03	2.550±0.166
NMU + KG	125	0.80±0.01	0.31± 0.04	4.50±0.81	0.30±0.01	0.499±0.012
NMU + KG	250	0.76±0.03	0.34± 0.03	466±0.73	0.33±0.27	1.068±0.087
NMU + KG	500	0.70±0.10	0.44± 0.06	6.69±0.33	0.51±0.61	1.576±0.506
NMU + KG	1000	0.42±0.03	0.63±0.02	7.69±0.46	0.77±0.04	2.139±0.133

All values are expressed as mean ± SEM (n=6).

Table No: 8Showing the Estimation of Mitochondrial TCA-Cycle Enzymes.

Group	**Dose (mg/kg)**	**ICD (nmol/mg)**	**KGD (mmol/mg)**	**SD (µmol/mg)**	**MD (NADH/mg)**
Control	Vehicle(5ml/kg)	61.17± 2.893	25.32±0.189	2.12±1.027	20.19±0.196
NMU control	Vehicle (5ml/kg)	40.08±2.218	18.25±0.137	0.74± 1.002	12.14±0.194
NMU + TA	10	56.43±2.562	24.06±0.459	2.01±0.143	18.93±0.385

NMU + KG	125	44.91±1.3092	18.89± 0.619	0.88± 1.033	12.36±0.184
NMU + KG	250	45.06±1.136	18.68± 0.633	0.94± 0.048	12.01±0.112
NMU + KG	500	51.39±1.640	21.35± 0.552	1.63±0.318	14.53±0.441
NMU + KG	1000	53.01±1.211	22.59±0.193	1.71±0.288	17.55±0.683

All values are expressed as mean ± SEM (n=6).

REFERENCES

1. Prevention of Breast & Endometrial Carcinoma In Postmenopausal Women Through Ayurveda - Dr. Jasmine Gujarathi& Dr. ARV Murthy, Lecturer, Department of Prasutitantra&Striroga, Dean & Superintendent, G. J. Patel Institute of Ayurvedic studies and Research, Gujarat.
2. Sharma P.V, Charakasamhita, Varanasi, ChaukhambaOrientalia,1981.
3. Bhishagratha K.L, Sushrutasamhita, Varanasi, ChaukhambaOrientalia, 1991.
4. http://www.breastcancerindia.net/statistics/stat_global.html.
5. http://ww5.komen.org/BreastCancer/LateEffects.html
6. http://www.cancerresearchuk.org/about-cancer/type/breast-cancer/secondary/about/what-is-secondary-breast-cancer
7. https://www.ncbi.nlm.nih.gov/pubmed/20361359.
8. Cancer - An Ayurvedic perspective - PremalathaBalachandran, RajgopalGovindarajan, National Center for Natural Products Research, Department of Pharmacognosy, University of Mississippi, MS 38677, USA and Department of Biochemistry and Molecular Biology, University of Nebraska Medical Center, Omaha, NE 68198-4525, USA, Pharmacological Research 51 (2005) 19–30, Accepted 23 April 2004, ELSIVIER.
9. Ayurvedic Formulary of India, Part -1, Ministry of Health and Family Welfare, Dept. of ISM & Homeopathy, Third edition-2003.
10. AcharyaSharangdhara, SharangdharaSamhita- MadhyamaKhanda, ChaukhambaOrientalia, Varanasi, 4thEdition, 2005, P No: 205.
11. Jin-Yuarn Lin, Ching-Yin Tang., Determination of total phenolic and flavonoid contents in selected fruits and vegetables, as well as their stimulatory effects on mouse splenocyte proliferation, Food Chemistry 101 (2007) 140–147.
12. EdoardoGaude and Christian Frezza, Defects in mitochondrial metabolism and cancer, Bio-med central- The open access Publisher, Published online 2014 Jul 17, PMCID: PMC4108232.
13. B. Rajkapoor, et al, Antitumour activity of *Bauhinia variegata*on Dalton's asciticlymphoma., Journal of Ethnopharmacology 89 (2003) 107–109.
14. B. Rajkapoor, et al.,Chemoprevention and cytotoxic effect of *Bauhinia variegata*against*N*-nitrosodiethylamine induced liver tumors and human cancer cell lines., Journal of Ethnopharmacology 104 (2006) 407–409.
15. Min Ji An, Jae HeeCheon, Seung Won Kim, EunSoo Kim, Tae Il Kim, Won Ho Kim.,
    Guggulsterone induces apoptosis in colon cancer cells and inhibits tumor growth in murine colorectal cancer xenografts., Cancer Letters 279 (2009) 93–100.
16. VaiyapuriManju, NamasivayamNalini T., Chemopreventive efficacy of ginger, a naturally occurring anticarcinogen during the initiation, post-initiation stages of 1,2 di-

methylhydrazine-induced colon cancer., ClinicaChimicaActa 358 (2005) 60–67.
17. YogeshwerShukla, Madhulika Singh., Cancer preventive properties of ginger: A brief review., Food and Chemical Toxicology 45 (2007) 683–690.
18. E. S. Sunila, G. Kuttan., Immunomodulatory and antitumor activity of *Piper longum*Linn. &piperine, Journal of Ethnopharmacology, Volume 90, Issues 2-3, February 2004, Pages 339-34.
19. S. Kaura, S. Aroraa, K. Kaura, S. Kumar., The *in vitro*antimutagenic activity of Triphala -an Indian herbal drug., Food and Chemical Toxicology 40 (2002) 527–534.
20. Mohammad Saleem., Lupeol, a novel anti-inflammatory and anti-cancer dietary triterpene., Cancer Letters 285 (2009) 109–115.
21. PriyangaRanasinghe, ShehaniPigera, GA SirimalPremakumara, PriyadarshaniGalappaththy, Godwin.R. Constantine, and Prasad Katulanda,Medicinal properties of 'true' cinnamon (*Cinnamomumzeylanicum*): a systematic review- 2013 Oct 22, PMC-ID: PMC3854496.
22. K. Nagendra Prasad, Bao Yang, Xinhong Dong, Guoxiang Jiang, Haiyan Zhang, HaihuiXie, Yueming Jiang., Flavonoid contents and antioxidant activities from Cinnamomum species., Innovative Food Science and Emerging Technologies 10 (2009) 627–632.

CORRESPONDING AUTHOR

Dr. Remya A
Final Year PG Scholar,
Dept. of P.G studies in *Rasashastra and BhaishajyaKalpana*,
Amrita School of Ayurveda, Kollam, Kerala, India
Email: drremyaa@gmail.com

Source of Support: Nil
Conflict Of Interest: None Declared

How to cite this URL: Remya A Et Al: Evaluation Of The Antitumor Activity Of Ayurvedic Formulation Kanchanara Guggulu On N-Methyl-N-Nitrosourea (Nmu) Induced Mammary Tumor In Sprague-Dawley RatsInternational Ayurvedic medical Journal {online} 2017 {cited January, 2017} Available from: http://www.iamj.in/posts/images/upload/80_89.pdf