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THERAPEUTIC ASPECTS OF ONION IN TREATMENT OF CANCER AND RELATED ISSUES: A REVIEW

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ABSTRACT

Human has always found nature as its good mate. Human beings have always used herbal/ayurvedic remedies in the treatment of their several diseases with very less side effect. Allium species are one of the herbs whose parts like roots, leaves, stems and also juices is very useful for curing cancer, cardiovascular diseases, inflammation, reducing blood sugar, baldness, gastric ulcer, colic diseases, oxidative study (Khan, May 2017). Consumption of Allium vegetables indicated decreased cancer risk, particularly gastrointestinal tract cancers as reported by epidemiological studies; though of limited asses. Mechanistic studies give the major supporting evidence of cancer preventive effect of Allium vegetables. The studies highlight mechanism of compounds having sulfur, extracts of onion, various preparations and their lower activation of carcinogens, antioxidant, antimicrobial, antibacterial and oxidoreduction modification. Onion is also seen as reducing obesity and thus reducing the risk of cancer associated with potential obesity. Onion can be used as an obesity reducing agent by acting on the low-density cholesterol and increase high density lipoprotein cholesterol.

Keywords: Cancer, obesity, antioxidant, antibacterial, antiviral.

INTRODUCTION

Onion (*Allium cepa)* is originally from central Asia and it is one of the most cultivated plants and oldest plant which dates back to 4000 years. Traditionally, onions have been used worldwide for different food preparation and seasoning. The value of onions lies in their taste and chemical composition. The therapeutic value of onion is great. It acts as stimulants and mild counter-irritant. It has been a herbal remedy for ailments like cough, colds, influenza, bronchitis. Onions have very high assimilable iron content. Therefore, they are beneficial in treating anemia. Onion can be used as an effective preventive against heart diseases and cholera. *Allium cepa* is an effective herb in urinary system disorders. It is also very effective against bleeding piles; other uses can be demonstrated against teeth disorders, ear disorders, and tuberculosis (Tripathi, 04 June 2016). Onion can be used in the treatment of colorectal cancer (CRC); which is the third most common cancer worldwide and is the second most frequent cause of cancer death in the population. Selenomethionine (SeMet) and Se-methyl-L-selenocysteine (MSeC) are the compounds found in onion. In comparison to inorganic Se, these compounds have lower toxicity and better anticancer activities. Various studies have shown the effects of MSeC treatment on the growth of COLO 205 human colorectal adenocarcinoma cells and the mechanisms are evaluated related to MSeC-induced effects. MSeC shows 80% apoptosis in cells when they have been treated with COLO 205 cells with 200 µMMSeC for 24 h (Yen-Chen Tung, 2015).

Public health demand is increasingly concerned with the identification of bioactive foods, dietary methods, and compounds that may decrease cancer risk. The Allium genus is one food group that has raised considerable interest in its putative anticancer properties.

Allopathic medicines rely on medical practices which is a contrast to preventive measures for curing ailments. Researches on the curative and preventive effect of onion have shown promising results in curing of cardiovascular diseases, inflammation, diabetes, cancer prevention, immune system enhancement, antioxidant, and asthma.

Onion In Folk Medicine

Onion is used for both internal and external healing. Internally onion has been used for treating cough, bronchitis, asthma, colds, whooping cough, and other respiratory problems. It helps in decongestion in the lungs and thus expands the airways for respiration. Onion is used for relief of excess gas and stomach upset. Rue and onion mixture are used to get rid of parasites in the digestive system. Onion is thought to be an appetite stimulant and hair growth agent. Onion juice also prevents bacterial and fungal infections. Application of onion on wounds and stings removes warts. It is also used to reduce unwanted skin blemishes. Warm onion juice is used for earache and baked onion is used for the treatment of boils (Tripathi, 04 June 2016).

Bioactive Compounds

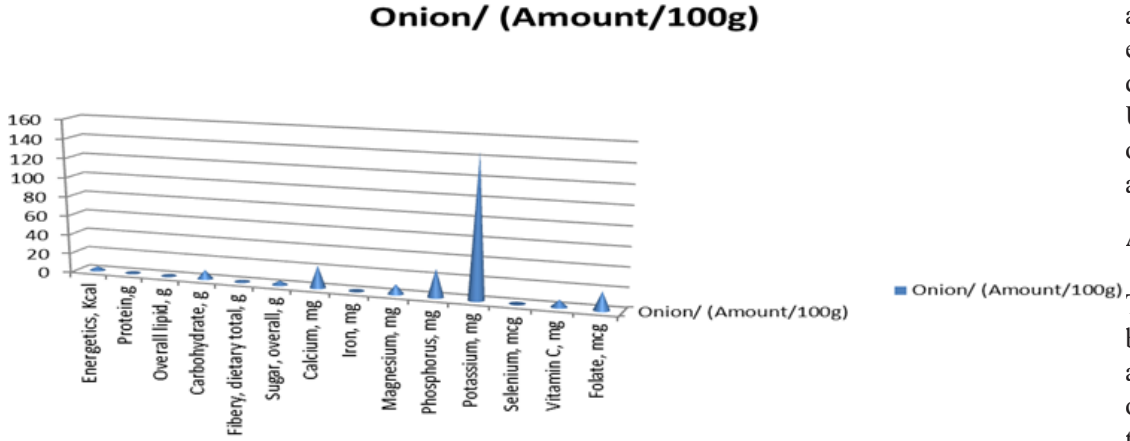
Allium cepa is a significant source of carbohydrates, potassium, fiber, vitamin C (table1); (U.S. Department of Agriculture, Agricultural Research Service. USDA, November 3, 2014) and iron. It contains a variety of

biologically active compounds like oligosaccharides, selenium (JA., 2006), arginine. Most of the health benefits and maximum studies of Allium, however, focus on its sulfur-containing compounds (JA., 2006). The cancer-preventive effects of *Allium cepa* are highlighted in this review. Sulfur comprises up to 0.5% of the dry weight of onions. The sulfur-containing components are largely derived from sulfoxides (ASCO) of ɣ- glutamyl-S-alk(en) yl-Leavo-cysteines and S-alk(en)yl-Leavo-cysteine. The predominant ASCO in onions is isoalliin (trans-(+)-S-(propen-1-yl)-Leavo-cysteine sulfoxide); fig 2 (Griffiths G, 2002). Propiin ((+)-S-propyl-Leavo-cysteine) and methiin ((+) -S-methyl-Leavo-cysteine sulfoxide) also contribute to the onion's ASCO content.

Bioactive compounds of sulphur in Allium cepa. The precursors to the bioactive compounds in Allium vegetables are ASCOs. From the ɣ-glutamyl-S-alk(en) yl-Leavo- cysteines ASCOs. The alliinase enzyme is released from the vacuoles when the onions are chopped or crushed or chewed and catalyses the conversion of ASCOs to violently reactive compounds such assulfenic acid intermediates. Condensation gives rise to thiosulfinate compounds via the intermediate's formation. The particular compound which is mainly responsible for the flavor and smell of onion are the thiosulfinate compounds and its metabolites. Thiosulfinate compounds and the predominant compounds of ASCOs are listed in the figure 2.

Properties of selenium containing chemicals

Nutrients of Allium



Deficiency of Selenium can cause Keshan disease. This is a cardiac disease results in CHF (congestive heart failure). It is mostly seen in young children. Selenium prevents damaging of tissue by oxidation by acting as cofactor for glutathione peroxidase. Selenium changes the metabolism of cancerous agents by involving in the oxidation system of liver. Selenium containing proteins helps in the prevention of cancer. Onion uptakes selenium from the soil and thus helps in the prevention. It helps in prevention of mammary gland cancer. Onion containing Se-methyl Selenocysteine prevents the occurrence of tumor.

Pharmacological activities of onion

Antimicrobial Activity

In the folklore medicine, onion has been used for bacterial, fungal and viral infections. The antimicrobial activity of onion can be used like natural preservative in foods. The chemical characterization of the sulphur compounds of onion had the main antimicrobial agents. The applications of volatile compounds of onion have limited use because of their strong flavor, relative biochemical instability and pungent properties. There has been a recent increase in study of the phenolic compounds which shows antimicrobial properties. They are more stable. Proteins and saponins contribute to this property.

Antibacterial Activity

DAS (diallylsulphide) and DADS (diallyldisulphide) are the predominantallicin-derived organo-sulphur antibacterial compounds (Tsao SM, 2001;Jul 1). Various researches show impacts of organ sulphur-containing components on the division of pathogen by both low inhibitory concentration and diffusion assay experiments. These suggest a high inhibition against gram positive bacteria of genus *Staphylococcus, Bacillus, Streptococcus, Micrococcus.* They are also active against gram negative bacteria like *Escherichia coli* strains and *Salmonella enteritidis* (Corzo-Martínez M, 2007 Dec 1).

Antiviral Activity

Onion doesn't have as much as antiviral activity as like antibacterial action. Quercetin (3, 5, 7, 3', 4'-tetrahydroxyflavone), which is a major flavonoid shows antiviral activity and enhances the antiviral drugs bioavailability. Unlike garlic lectins, onion lectins have an anti-HIV activity.

Antifungal Activity

The fungal cells can be destroyed by the active bio constituents of onion by decreasing the oxygen uptake, by changing the cell membrane's lipid profile by inhibiting the synthesis of proteins, lipids and nucleic acids, and also by inhibiting the fungal wall synthesis.

Antioxidant Activity

Various diseases like cancer, cardiovascular, neurodegenerative, inflammatory, diseases like Alzheimer's and also age-related degenerative conditions caused by oxidation of proteins, DNA, and lipids by reactive oxygen species (ROS) (Corzo-mart 2014). Onions contains kaempferol, anthocyanins pigments, and

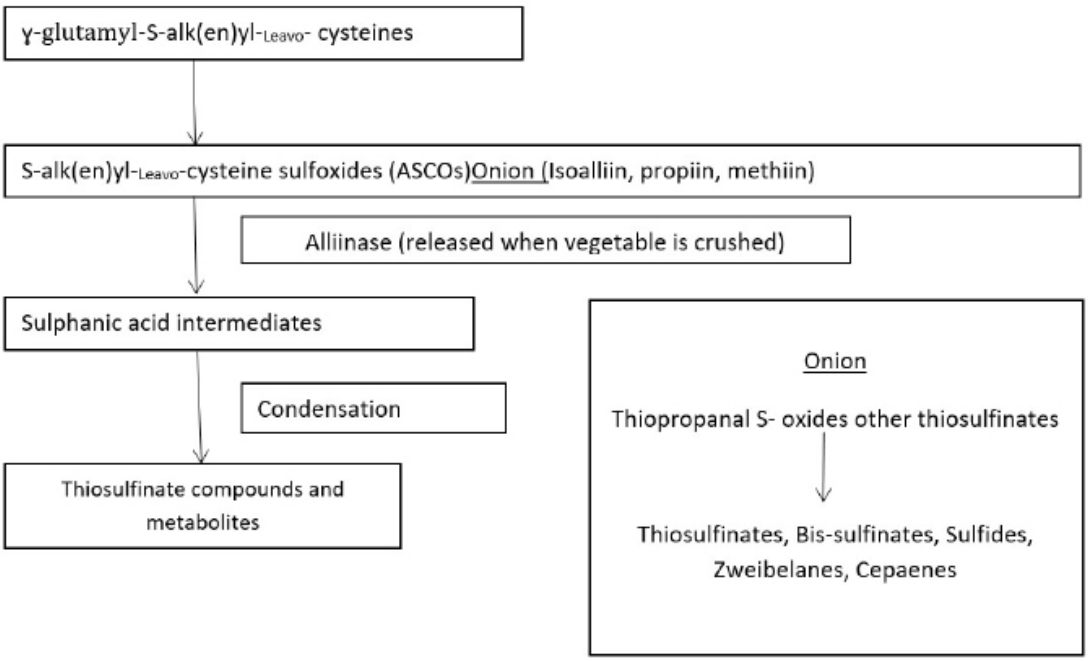


Figure 2. Synthesis of Thiosulfinatecompounds and metabolites

flavonoids like quercetin. The anthocyanins pigments in onion are concentrated on the outer shell; it is also present in minor constituents of the edible portion. Kaempferol are found in certain varieties of onion, but it is present in very less amount than quercetin. The quercetin is found in coupled form as quercetin4'-Ortho-βeta-glycopyranoside,quercetin 3,4'-Ortho-βeta-glycopyranoside and quercetin 3,7,4'-Ortho-βeta-triglycopyranoside. The outer layers contain quercetin glycoside which is effective antioxidants against of low-density lipoproteins and non-enzymatic lipid peroxidation. The dimerized compound of quercetin shows the highest antioxidative activity just like α-tocopherol(Corzo-Martínez M, 2007 Dec 1). The absorption of quercetin is low in comparison to dietary antioxidants like vitamins C and E. Quercetin has limited capability to act as antioxidant in *in vivo* plasma (Lotito, 2006). Some individuals show better absorption of quercetin than others because of particular polymorphism for transporters and intestinal enzymes. The main routes of quercetin are found in the gastrointestinal tract compartment.

There are two different pathways of absorption of quercetin in the intestine. The first path of absorption of quercetin is intestinal lumen and the then the second pathway is the SGLT-1 pathway (Sodium dependent Glucose transporter-1). The first pathway occurs by deglycosylation. The red onions show best anti-oxidation. The yellow onions have the highest amount of phenol. Wastes of onion can serve as one of the prime reservoirs of compounds which shows anti-oxidation.

Anticarcinogenic And Antimutagenic Activities

The tests done within the living body and the studies done in the test-tube based laboratory epidemiologic studies were developed to make the anti-carcinogen or chemopreventive effects of onion evident. Studies reveal that onion has a protective effect on cancer especially in case of gastric cancer, there is a correlation between onion intake and risk of stomach cancer. The anticarcinogen effect of onion against oesophagus and stomach is related to antibacterial properties. The inhibition of the growth of bacteria in the gastric cavity leads to decreased conversion of nitrate to nitrite in the stomach, thus decreasing the chances of formation of carcinogens internally like Nitrogen-nitroso compounds, and *Helicobacter pylori* infection becomes minimal (Van Den Brandt, 1996).

Intake of onion shows decreased risk of cancer of colon and rectum ((Steinmetz, 1994) , (Millen, 2007)), lung cancer, brain cancer, prostate cancer, bladder cancer, liver cancer, breast cancer, ovarian cancer, endometrial cancer and skin cancer.

The mechanism by which onion states antimutagenic and anticancer effects is illustrated in figure 4: the alteration of carcinogenic metabolism by inducing enzymes like NAD(P)H-dependent quinine reductase, glutathione S-transferase (GST) and UDP-glucuronosyltransferase, these are phase II enzymes. This increases the polarity of carcinogen, aiding the excretion from the body the inhibition of procarcinogens which are bioactive enzymes, antioxidant action due to oxidative damage inhibition.

The effect of onion was studied on the preneoplastic lesions in liver of rat which were chemically induced. It is reported that onion shows inhibitory effect on the first stage of hepatocellular carcinogenesis by suppressing the oxidative stress by modulation of the peroxidase (glutathione) activity, the GST, inhibiting the biological process cellular division, cellular proliferation apoptosis induction (Perchellet, 1990), (Brisdelli, 2007); inhibition of gene transcription (Bora, 2009), (Miodini, 1999); Ultra violet induced immunosuppression protection (Bora, 2009); and inhibition against cyclooxygenase and lipoxygenase (anti-inflammation effect) (Perchellet, 1990).

Regarding the bioactive components, several studies and investigations shows that the water- and lipid-soluble sulphur compounds in onion provides anticancer activity. Amid all of them the DAS groups like DPS (dipropylsulphide), DPDS (dipropyldisulphide), DAS (diallyldisulphide), SMC (S-methylcysteine), and SAC

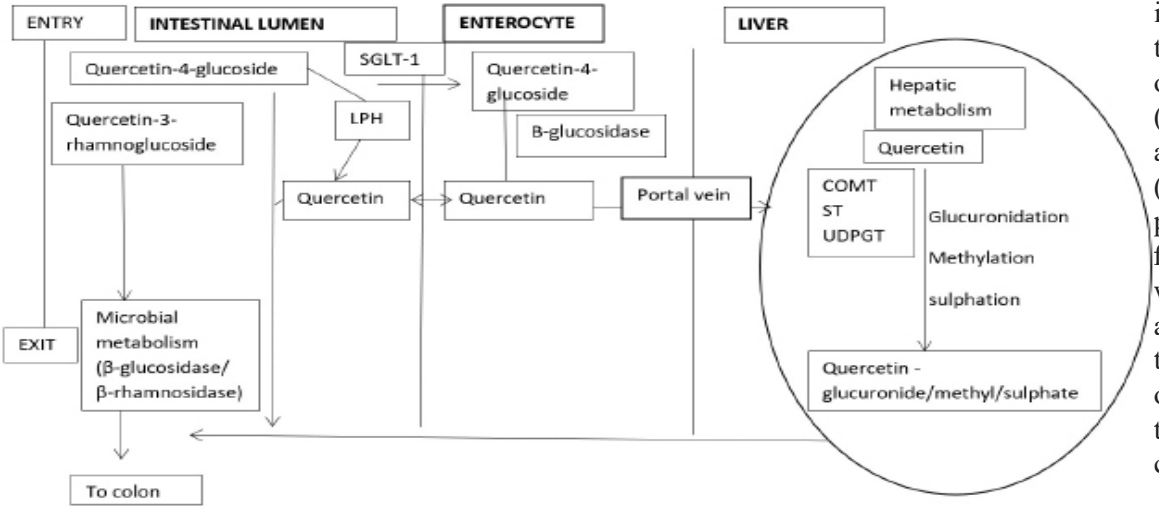


Figure 3. Simplified representation of the scheme of route of quercetin in small intestine (Jan, 2010).

(S-allyl cysteine) have shown inhibitory effect on the first stages and late stages of oesophagus, colon, lung, liver, kidney, mammary gland and forestomach carcinogenesis. Luteolin; a flavonoid present in onion can also serve as an anticancer, antitumor, antioxidant and non-inflammatory agent in the cancer testing models. It can stop the growth of skin tumors which are chemically grown in the rats. Luteolin can also prevent the ultraviolet B radiation caused cancer.

Methiin (sulphur compound) shows inhibitory effect on the cellular proliferation which shows apoptosis in cell cultures of human, as example leukemic human cells. Organo-sulphur compounds like tetra sulfides found naturally within the onions suppresses the sensitive cells proliferation and human breast resistant cancerous cells by selecting the cycle of cell division 25 phosphatase, important enzymes of cell cycle.

The organo-selenium components are more responsible for the anticancer activity of onion than organo-sulphur component. It is detected that onions which are Se-enriched shows more anticancer activity than common plants. The anticancer activity of can be increased by substituting S with Se.

The S-analogues are not as efficient as anticancer agent as the pure Se- compounds. Diallylselenide is 300 times more potent than DAS in mammal cancer reduction. The Se-components which have anticarcinogenic activity in onion is ɣ-glutamyl-Se-methyl selenocysteine and they are most chemopreventive. The different forms of selenium which are found in raw onions are selenite/ selenite, selenocysteine, selenomethionine.

The anticancer and antimutagenic property of onion (*Allium Cepa*) is may be due to the abundant presence of phenolics and flavonoids. The different extracts of yellow and red onion from the white peel and flesh have different cancer preventive activity; due to difference in total amount of phenolics and flavonoids as quercetin. The peels which have highest amount of phenolics and flavonoids show inhibitory effect on the cancerous cells of stomach, colon (Jang, 2009) breast and prostate cancer (Jeong, 2009) more potently than the flesh of onion. The white onion extracts are less potent than the red and yellow onion. It is because there is more content of flavonoids and phenolics in red and yellow onion.

On a study of the antimutagenic and antioxidant properties of onion with several red onion peel extracts of varying polarity

(Singh, 2009). Maximum number of polyphenols are contained in the ethyl acetate fraction, including quercetin, kaempferol, ferulic, gallic, protocatechuic acids may be the reason of its potent antimutagenic and antioxidant properties.

In reports it has been seen that quercetin increases the bioavailability of some anticancer medicines like Tamoxifen, which is a non-steroidal antiestrogen used for treatment of breast cancer and also helps in cancer prevention. It helps by reduction in metabolism and promoting intestinal absorption (Shin, 2006), (Wu, 2005) In studies it is reported that synergistic effect of quercetinsulforaphane (it is an anticancer agent found in the broccoli its chemical name is 1-isothiocyanato-4-(methylsulfinyl)-butane an isothiocyanate family member) shows better anticancer effect on melanoma migration and proliferation (B16F10) rather than one compound used alone.

Management Of Obesity

Taking increased amount of onion is directly related with treatment and avoidance of obesity. Onion (Allium cepa) supplements decrease the mesenteric fats and induce the adipokine generation at a transcriptional fat and models of obese animal (high-fat induced). Extracts of onion decreases the LDL (low density lipoproteins) cholesterol level in the Sprague-Dawley rats who are given high-fat foods. Some scientists have given reports 70% ethanol extracts of onion (Allium fistulosum L.) have anti-obesity activity. This effect was shown in obese mouse. The onion extract has shown reduction in weight of the treated mouse and also showed decreased size of adipocyte and reduced weight of adipose tissue. Various studies have shown that there is link between obesity and cancer. And onion is very beneficial for loss of weight and thus can be

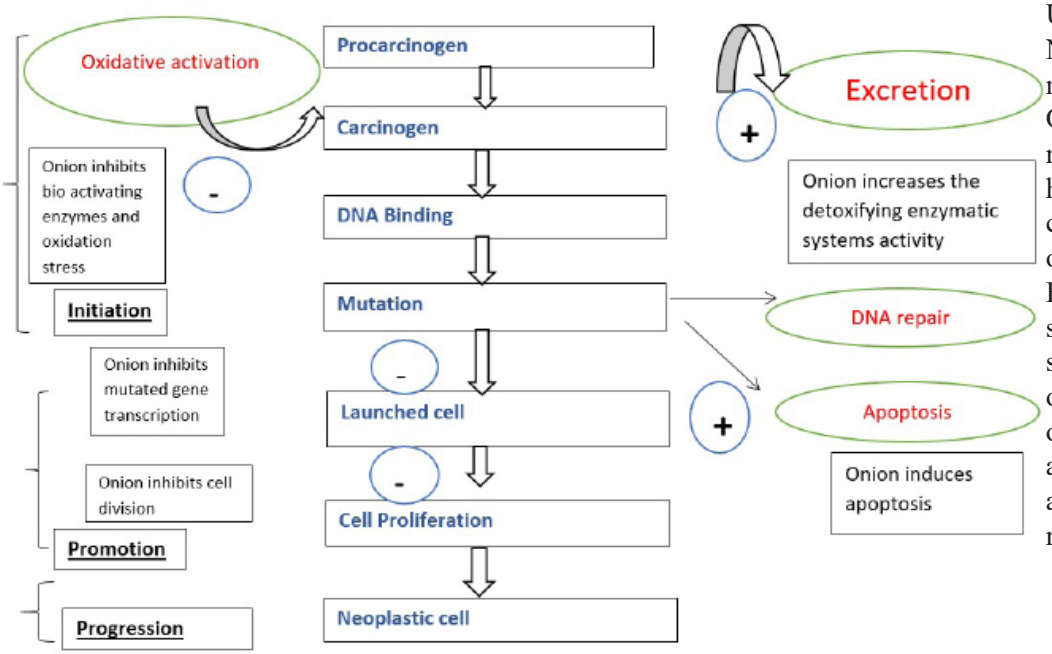


Figure 4. The biosynthesis pathway of cholesterol

targeted for anti-cancer and anti-obesity activities. Onion has shown antagonistic activity on FAS over-expressed adipocytes and cancer cells (Wang, Tian, and Ma 2012).

Various Advantages

Onions shows anti-asthmatic effect due to its thiosulfinate and cepaenes. They show antagonistic effect on COX and LOX. Onion also shows anti-allergic property mainly against Type-I allergies. Onion makes the digestion process faster; it decreases the transitional time in the GIT pathway. Quercetin present in onion causes spasmolysis through Ca^{2+} channels.

Onion shows prebiotic effect due to the more amount of fiber. This leads to growth of good bacteria which are beneficial for health in the gut. Onion is also used as food preservative due to presence of inulin. There is also an androgenic influence of onion on the sperm, which affects the viability of sperm. Consumption of onion also leads to decreases prostate cancer.

CONCLUSIONS

Onion is a long-used food ingredient and it also has various biological properties. It is a natural herb and acts as antioxidant, anticancer, antiviral, antifungal and antibacterial agent. The anti-carcinogenic activity is mainly due to the sulphur and selenium containing compounds of onion. The phenolic and quercetin derivatives also contribute to the anti-cancer activity. Despite of plentiful studies on profitable effects of onion the adversity which always comes is its bad breath, gastrointestinal upsets. In this report the health benefits of onion is highlighted and how it can be totally used to meet the necessities of human beings.

On the other hand, obesity is a growing problem in developing and developed nations. Countries like United States, Mexico and New Zealand have the most problem of obesity. Obesity is one of the major reasons of cancer growth in human body. 23% of breast cancer is caused due to obesity problem in women. Epidemiological studies suggest intake of onion shows decrease in risk of obesity-related cancer. So, onion could be a great boom and a one stop solution to all our cancer and obesity related issues.

REFERENCES

Aboubakr, H.A., Nauertz, A., Luong, N.T., Agrawal, S., El-Sohaimy, S.A., Youssef, M.M. and Goyal, S.M., 2016. In vitro antiviral activity of clove and ginger binary compound extracts against feline calicivirus, a surrogate for human norovirus. *Journal of food protection*, *79*(6), pp.1001-1012.

Benkeblia, N., 2004. Antimicrobial activity of essential oil extracts of varied onions (Allium cepa) and garlic (Allium sativum). *LWT-food science and technology*, *37*(2), pp.263-268.

Campos, K.E., Diniz, Y.S., Cataneo, A.C., Faine, L.A., Alves, M.J.Q.F. and Novelli, E.L.B., 2003.*International journal of food sciences and nutrition*, *54*(3), pp.241-246.

Corzo-Martínez M, C. N. (2007 Dec 1). Biological properties of onions and garlic. Trends in food science & technology. 18(12):609-25.

Harlita, T.D. and Oedjijono, A.A., 2018. The antibacterial activity of dayak onion (Eleutherinepalmifolia (L.) merr) towards pathogenic bacteria. *Tropical life sciences research*, *29*(2), p.39.

Khan, S. A. (May 2017). Medicinal Importance of Onion: A current review. International.*Journal of Pharmaceutical Science and Research,* 29-39.

Lee, B., Jung, J.H. and Kim, H.S., 2012. Red onion on antioxidant activity in rat. *Food and chemical toxicology*, *50*(11), pp.3912-3919.

Prakash, D., Singh, B.N. and Upadhyay, G., 2007. Antioxidant scavenging activities of phenols from onion (Allium cepa). *Food chemistry*, *102*(4), pp.1389-1393.

Ramos, F.A., Takaishi, Y., Shirotori, M., Kawaguchi, Y.,

Tsuchiya, K., Shibata, H., Higuti, T., Tadokoro, T. and Takeuchi, M., 2006.Antibacterial and antioxidant activities of quercetin oxidation products from yellow onion (Allium cepa) skin. *Journal of agricultural and food chemistry,* 54(10), pp.3551-3557.a

S Bisen, P. and Emerald, M., 2016.Nutritional and therapeutic potential of garlic and onion (Allium sp.). *Current Nutrition & Food Science*, *12*(3), pp.190-199.

Santas, J., Almajano, M.P. and Carbó, R., 2010. (Allium cepa, L.) extracts. *International journal of food science & technology*, *45*(2), pp.403-409.

Saxena, A., Tripathi, R.M. and Singh, R.P., 2010. Biological synthesis of silver nanoparticles by using onion (Allium cepa) extract and their antibacterial activity. *Dig J Nanomater Bios*, *5*(2), pp.427-432.

Tripathi, P.C. and Lawande, K.E., Therapeutic and Medicinal value of onion and garlic.

Yen-Chen Tung, †. M.-L.-L.-S.-T. (2015). Se-Methyl L selenocysteine Induces Apoptosis via Endoplasmic Reticulum Stress and the Death Receptor Pathway in Human Colon.*Agricultural and food chemistry,* vol63, 5008-5016.

Zohri, A.N., Abdel-Gawad, K. and Saber, S., 1995. Antibacterial, antidermatophytic and antioxygenic activities of onion (Allium cepa L.) oil. *Microbiological research*, *150*(2), pp.167-172.