

## Diet and Cancer: A Mini Review

Nastasia Belc and Gabriel Mustatea\*

National Research and Development Institute for Food Bioresources, IBA Bucharest 5 Ancuta Baneasa Street, 020232, Bucharest, Romania

### Abstract

Cancer is one of the leading causes of death all over the world. The number of cancer cases is expected to increase up to 24 million by 2035. Several studies were performed in the last years in order to explore and analyze associations between diet and risk of cancer. The use of nutraceuticals, food contamination with mycotoxins, honey properties as well as lifestyle recommendations are the main topics highlighted in this mini review. The risk of cancer is depending on degree of exposure to contaminated food, availability of nutrients (ex. nutraceuticals) to the body, dietary pattern and lifestyle as well as food behavior.

**Keywords:** Cancer; Diet; Nutraceuticals; Lifestyle; Food contamination

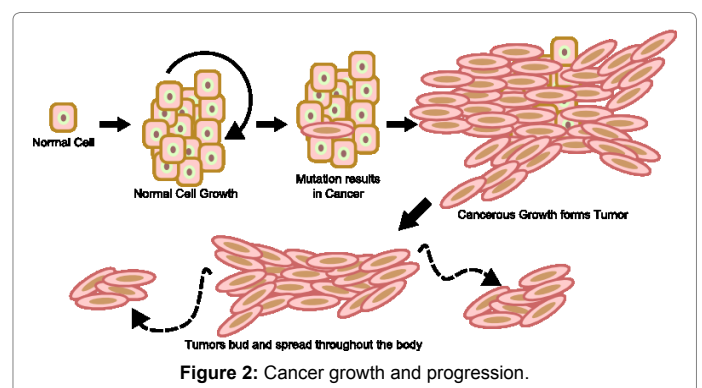
### Introduction

Cancer is one of the leading causes of death throughout the world: there were an estimated 14.1 million cancer cases around the world in 2012, of these 7.4 million cases were in men and 6.7 million in women. This number is expected to increase to 24 million by 2035 (<http://gco.iarc.fr/>) (Figure 1) Cancer is a widespread disease that affects a large majority of the population either directly, because they develop it, or indirectly, because they know or are related to someone with the disease. Cancer can form in almost any organ or area of the body, being a major and increasing health concern [1,2]. Cancer growth and progression it is shown schematically in (Figure 2).

### Diet and Nutrition

In the 80s, Doll and Peto published a review regarding factors known (at that time) to affect cancer risk [3]. The main cancer risk factors described by Doll and Peto are: tobacco, diet and nutrition, occupation and infection. Doll and Peto stated that epidemiological evidence regarding diet and cancer was largely indirect. They made an estimate by cancer site and they indicated that “perhaps” 90% of stomach and colorectal cancers, 50% of pancreas and breast cancers, 20% of lung cancers and 10% of other cancers may be diet related [3,4].

In the last decades, several studies were performed in order to explore and analyze associations between diet and risk of cancer. World Cancer Research Fund and American Institute for Cancer Research [5],

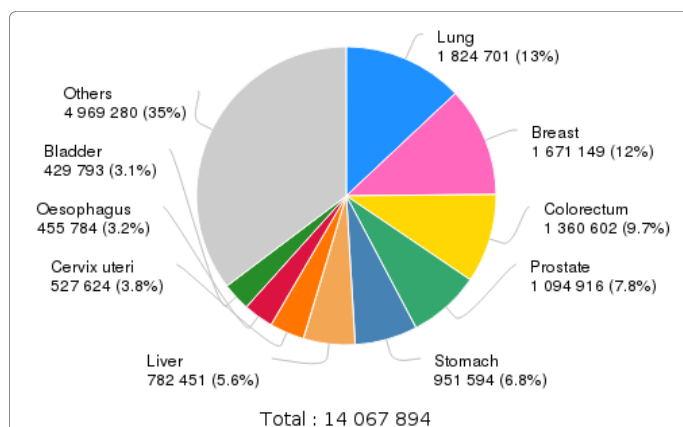


World Health Organization [6], U.S. Department of Health and Human Services and U.S. Department of Agriculture [7], American Diabetes Association [8], etc. published several comprehensive reports related to diet and cancer.

In order to explore associations between dietary patterns and risk of cancer index-based approaches were increasingly used. The commonly used approach is Healthy Eating Index (HEI), developed based on the Dietary Guidelines for Americans recommendations. As shown in several research papers [9-16], higher HEI scores are related to lower risk of cancers.

According to Solbak et al. [17] after assessing dietary quality in a subset of participants in Alberta’s Tomorrow Project (ATP), the data suggest that higher quality diets may be protective against cancer in men, but not women.

Nutraceuticals, for example, are bioactive molecules found in foods, like curcumin, resveratrol, genistein, quercetin, lycopene, etc. (Figure



**Figure 1:** Estimated number of incident cases, both sexes, worldwide (top 10 cancer sites) in 2012.

\*Corresponding author: Gabriel Mustatea, National Research and Development Institute for Food Bioresources, IBA Bucharest 5 Ancuta Baneasa Street, 020232, Bucharest, Romania, Tel: +4031.6205833; Fax: +4031.6205833; E-mail: [gabi.mustatea@bioresurse.ro](mailto:gabi.mustatea@bioresurse.ro)

Received March 15, 2018; Accepted April 05, 2018; Published April 22, 2018

Citation: Belc N, Mustatea G (2018) Diet and Cancer: A Mini Review. J Nutr Food Sci 8: 688. doi: [10.4172/2155-9600.1000688](https://doi.org/10.4172/2155-9600.1000688)

Copyright: © 2018 Belc N, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

3). They have been shown to exert anticancer activity [17]. The main factors limiting the oral bioavailability of anticancer nutraceutical are: bioaccessibility (liberation from foods and solubilization in gastrointestinal tract fluids), absorption (transport through mucus layer and into epithelium cells) and transformation (chemical or biochemical modifications). They are schematically presented in (Figure 4) [17].

Based on the mentioned aspects, functional foods must be carefully designed to contain nutraceuticals themselves or to boost the bioavailability of nutraceuticals in other foods. Further research is still needed to demonstrate the efficacy of nutraceuticals.

Several studies have also shown how the antioxidant and anti-inflammatory effect of honey can prevent the initiation of cancer, although the full mechanism is not well defined yet. Honey is composed of various sugars, flavonoids, phenolic acids, enzymes, amino acids, proteins and minerals. Its composition varies according to floral sources and origin [18]. Honey shows antiproliferative activity, both in vitro and in vivo, inducing apoptosis and cell cycle arrest. Furthermore, honey improves the activity of anticancer drugs other than ameliorating life quality of patients undergoing chemotherapy [19-27].

On the opposite site, food contamination by mycotoxins, among other chemical contaminants, has been recognized as a public health

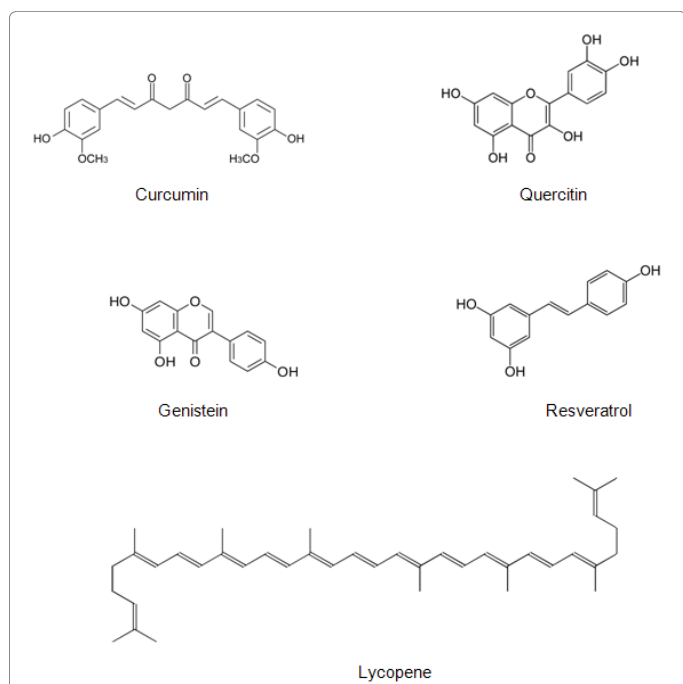


Figure 3: Chemical structure of bioactive molecules (nutraceuticals) found in foods.

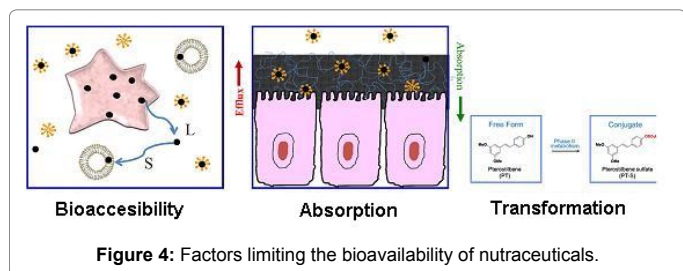


Figure 4: Factors limiting the bioavailability of nutraceuticals.

Recommendations
<b>Body fatness</b> Be as lean as possible within the normal range of body weight
<b>Physical activity</b> Be physically active as part of everyday life
<b>Foods and drinks that promote weight gain</b> Limit consumption of energy-dense foods and avoid sugary drinks
<b>Plant foods</b> Eat foods mostly of plant origin
<b>Animal foods</b> Limit intake of red meat and avoid processed meat
<b>Alcoholic drinks</b> Limit alcoholic drinks
<b>Preservation, processing, preparation</b> Limit consumption of salt Avoid moldy cereals (grains) or pulses (legumes)
<b>Dietary supplements</b> Aim to meet nutritional needs through diet alone
<b>Breastfeeding</b> Mothers to breastfeed; children to be breastfed
<b>Cancer survivors</b> Follow the recommendations for cancer prevention

Table 1: Lifestyle recommendations for cancer prevention [47].

threat [28,29] and mycotoxins have been included as priority food contaminants by World Health Organization (WHO) [30]. Aflatoxin B1, Aflatoxin M1, Ochratoxin and Deoxynivalenol are potent toxic mycotoxins [31], Aflatoxin B1 being classified by International Agency for Research on Cancer (IARC) as “carcinogenic to humans” [32]. Mycotoxins occur in highly consumed foods such as cereals, milk, dairy products, fruits, coffee, wine, beer [33]. Mycotoxins have been ranked as “the most important chronic dietary risk factor” [34,35]. Data related to dietary exposure of humans to mycotoxins are limited; however there are some published articles in this regard [36-45].

Thousands of dietary components are consumed each day, meaning that a typical diet may provide more than 25,000 bioactive food constituents, and the amounts of bioactive components within a particular food may widely vary [46,47]. Each bioactive food constituent has the potential to modify multiple aspects of the cancer process, either alone or in combination with several micronutrients as well as quantity, timing and duration of exposure modulate the cell response [47].

Lifestyle recommendations for cancer prevention were drawn up on the basis of nutrition-related factors judged to be convincingly or probably causally related to cancer, according to predefined criteria for judging the strength of the evidence regarding causality [47,48]. Concluding, based on the recommendations presented in (Table 1), a healthy diet for cancer prevention is: a diet that allows a person to be as lean as possible without being underweight; a diet rich in fruits, vegetables, whole grains and pulses; a diet that contains low amounts of red meat; a diet that does not contain processed meats; a diet that limits salt intake. Avoidance of sugary drinks, limited intake of calorie-rich foods and limited consumption of alcohol drinks is also recommended for a healthy diet.

## Conclusion

The links between diet and cancer are complex. The risk of cancer is depending on degree of exposure to contaminated food, availability of nutrients (ex. nutraceuticals) to the body, dietary pattern and lifestyle and food behavior. There are a lot of evidences about specific contaminants known as cancer factor risks but a specific diet with an effective protective role is still unknown.

## References

- Eheman C, Henley SJ, Ballard-Barbash R, Jacobs EJ, Schymura MJ, et al. (2012) Annual report to the nation on the status of cancer, 1975-2008, featuring cancers associated with excess weight and lack of sufficient physical activity. *Cancer* 118: 2338-2366.
- Siegel R, Naishadham D, Jemal A (2013) Cancer statistics. *CA Cancer J Clin* 63: 11-30.
- Doll R, Peto R (1981) The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. *J Natl Cancer Inst* 66: 1191-1308.
- Blot WJ, Tarone RE (2015) Doll and Peto's quantitative estimates of cancer risks: holding generally true for 35 years. *J Natl Cancer Inst* 107: 1-5.
- [http://www.aicr.org/assets/docs/pdf/reports/Second\\_Expert\\_Report.pdf](http://www.aicr.org/assets/docs/pdf/reports/Second_Expert_Report.pdf)
- World Health Organization (2003) Diet, nutrition and the prevention of chronic diseases. WHO Technical Report Series.
- <https://health.gov/dietaryguidelines/dga2005/document/default.htm>
- American Diabetes Association. (2016) Foundations of care and comprehensive medical evaluation. Section 3 in standards of medical care in diabetes. *Diabetes Care* 39: S23-S35.
- Guenther PM, Casavale KO, Reedy J, Kirkpatrick SI, Hiza HA, et al. (2013) Update of the healthy eating index: HEI-2010. *J Acad Nutr Diet* 113: 569-580.
- Harmon BE, Boushey CJ, Shvetsov YB, Ettienne R, Reedy J, et al. (2015) Associations of key diet-quality indexes with mortality in the multiethnic cohort: the dietary patterns methods project. *Am J Clin Nutr* 101: 587-597.
- Reedy J, Krebs-Smith S, Miller P, Liese AD, Kahle LL, et al. (2014) Higher diet quality is associated with decreased risk of all-cause, cardiovascular disease, and cancer mortality among older adults. *J Nutr* 144: 881-889.
- George SM, Ballard-Barbash R, Manson JE, Reedy J, Shikanyet JM, et al. (2014) Comparing indices of diet quality with chronic disease mortality risk in postmenopausal women in the women's health initiative observational study: evidence to inform national dietary guidance. *Am J Epidemiol* 180: 616-625.
- Liese AD, Krebs-Smith SM, Subar AF, George SM, Harmon BE, et al. (2015) The dietary patterns methods project: synthesis of findings across cohorts and relevance to dietary guidance. *J Nutr* 145: 393-402.
- Ye X, Scott T, Gao X, Maras JE, Bakun PJ, et al. (2013) Mediterranean diet, healthy eating index 2005, and cognitive function in middle-aged and older Puerto Rican adults. *J Acad Nutr Diet* 113: 276-281.
- Mertens E, Deforche B, Mullie P, Lefevre J, Charlier R, et al. (2015) Longitudinal study on the association between three dietary indices, anthropometric parameters and blood lipids. *Nutr Metab* 12: 47.
- Vargas AJ, Neuhaus ML, George SM, Thomson CA, Rohan TE, et al. (2016) Diet quality and colorectal cancer risk in the women's health initiative observational study. *Am J Epidemiol* 184: 23-32.
- Solbak NM, Xu JY, Vena JE, Csizmadia I, Whelan HK, et al. (2017) Diet quality is associated with reduced incidence of cancer and self-reported chronic disease: observations from Alberta's tomorrow project. *Prev Med* 101: 178-187.
- Gheldof N, Wang XH, Engeseth NJ (2002) Identification and quantification of antioxidant components of honeys from various floral sources. *J Agric Food Chem* 50: 5870-5877.
- Ahmed S, Othman H (2013) Honey as a potential natural anticancer agent: a review of its mechanisms. *Evid Based Complement Altern Med* 1-7.
- Kuppusamy P, Yusoff MM, Maniam GP, Ichwan SJA, Soundharajan I, et al. (2014) Nutraceuticals as potential therapy for colon cancer: a review. *Acta Pharm Sin B* 4: 173-181.
- Lopez-Lazaro M (2007) Dual role of Hydrogen peroxide in cancer: possible relevance to cancer chemoprevention and therapy. *Cancer Lett* 252: 1-8.
- Bennett LL, Rojas S, Seefeldt T (2012) Role of antioxidants in the prevention of cancer. *J Exp Clin Med* 4: 215-222.
- Hassan MI, Mabrouk M, Shehata HH, Aboelhussein MM (2012) Antineoplastic effects of bee honey and *Nigella sativa* on hepatocellular carcinoma cells. *Integr Cancer Ther* 11: 354-363.
- Takruri HR, Shomaf MS, Shnaigat SF (2017) Multi floral honey has a protective effect against mammary cancer induced by 7,12-Dimethylbenz(a)anthracene in sprague dauley rats. *J Agric Sci* 9: 196-204.
- Hegazi A, Al Tahtawi RHM, Abd-Allah F, Abdou AM (2014) Antitumor and antioxidant activity of honey in mice bearing Ehrlich Ascite carcinoma. *Acad J Cancer Res* 7: 208-214.
- Attia WY, Gabry MS, El-Shaikh KA, Othman GA (2008) The anti-tumor effect of bee honey in Ehrlich ascite tumor model of mice is coincided with stimulation of the immune cells. *Egypt J Immunol* 15: 169-183.
- Hegazi AG, Abdel-Rahman EH, Abd-Allah F, Abdou AM (2015) Influence of honey on immune status in mice-bearing Ehrlich Carcinoma. *J Clin Cell Immunol* 6: 1-6.
- JECFA (2002) Evaluation of certain mycotoxins in food: fifty-sixth report of the joint FAO/WHO expert committee on food additives. WHO technical report series No 906. WHO, Geneva, Switzerland.
- Raad F, Nasreddine L, Hilan C, Bartosik M, Parent-Massin D, et al. (2014) Dietary exposure to aflatoxins, ochratoxin A and deoxynivalenol from a total diet study in an adult urban Lebanese population. *Food Chem Toxicol* 73: 35-43.
- <http://whqlibdoc.who.int/hq/2002/9241562196.pdf>
- Diaz DE (2005) The mycotoxin blue book. University Press, Nottingham.
- WHO, IARC (1993) Monographs on the evaluation of carcinogenic risks to humans: some naturally occurring substances: food items and constituents, heterocyclic aromatic amines and mycotoxins, Lyon, France, p: 599.
- Weidenborner M (2008) Mycotoxins in foodstuffs. Springer, New York, pp: 1-503.
- Kuiper-Goodman T (1998) Food safety: mycotoxins and phycotoxins in perspective. In: Miraglia M, van Edmond H, Brera C, Gilbert J (9th Edn), mycotoxins and phycotoxins-developments in chemistry, toxicology and food safety. Proceedings of the IX IUPAC international symposium. Alaken Inc., Collins, CO, pp: 25-48.
- Bennet JW, Klich M (2003) Mycotoxins. *Clin Microbiol Rev* 16: 497-516.
- Verger P (2013) Risk analysis paradigm and total diet studies. In: Moy GG, Vannoort RW (Edn), total diet studies. Springer, pp: 19-26.
- Soubra L, Sarkis D, Hilan C, Verger P (2009) Occurrence of total aflatoxins, ochratoxin A and deoxynivalenol in foodstuffs available on the Lebanese market and their impact on dietary exposure of children and teenagers in Beirut. *Food Addit Contam* 26: 189-200.
- Nasreddine L, Nashalian O, Naja F, Itani L, et al. (2010) Dietary exposure to essential and toxic trace elements from a total diet study in an adult Lebanese urban population. *Food Chem Toxicol* 48: 1262-1269.
- Cuadrado C, Kumpulainen J, Moreiras O (1995) Contaminants and nutrients in total diets in Spain. *Eur J Clin Nutr* 49: 767-778.
- Ruprich J (1998) The 1997 Total diet study of the Czech Republic.
- <http://www.inchem.org/documents/jecfa/jecmono/v52je01.htm>
- Egan SK, Tao SSH, Pennington JAT, Bolger PM (2002) US Food and drug administration's total diet study: exposure assessment of nutritional and toxic elements, 1991-1996. *Food Addit Contam* 19: 103-120.
- Sommerfeld G (2004) Exposure assessment based on the results of the German food monitoring programme. In: proceedings of the world health organization third international workshop on total diet studies, 17-21 May 2004, Paris, France.
- Leblanc JC, Tard A, Volatier JL, Verger P (2005) Estimated dietary exposure to principal food mycotoxins from The First French Total Diet Study. *Food Addit Contam* 22: 652-672.
- Sirof V, Fremy JM, Leblanc JC (2013) Dietary exposure to mycotoxins and health risk assessment in the second French total diet study. *Food Chem Toxicol* 52: 1-11.
- <http://www.who.int/dietphysicalactivity/publications/trs916/en/>
- Norat T, Scoccianti C, Boutron-Ruault MC, Anderson A, et al. (2015) European code against cancer 4th Edn: diet and cancer. *Cancer Epidemiology* 39S: S56-S66.
- Wiseman M (2008) The second world cancer research fund/American institute for cancer research expert report. Food, nutrition, physical activity, and the prevention of cancer: a global perspective. *Proc Nutr Soc* 67: 253-256.