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Effects of moderate beer consumption on health

Efectos del consumo moderado de cerveza en la salud

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Abstract

According to the scientific literature, alcohol effects on health are dose-dependent, since beneficial effects have been observed when consumed at moderate level compared to abstinence or excessive consumption, in both observational and interventional studies. There are specifically two components in fermented beverages, mainly related to the beneficial effects on health when consumed in a moderate amount, namely polyphenolic compounds and ethanol. Indeed, a higher bone density has been reported in several studies, which has been associated to its polyphenolic compounds. Regarding cardiovascular and immunological effects, both polyphenols and ethanol seem to account for the anti-inflammatory and antioxidant functions.

Promising research in the moderate consumption of alcoholic beverages have reported that the polyphenolic fraction of fermented drinks could benefit the gut microbiota composition and thus, host metabolism and health, suggesting that particularly, beer could be a new target for microbiome-based studies.

However, it is very important to highlight that the moderate amount of beer must be consumed within an adequate lifestyle in order to avoid possible risks to develop non-communicable diseases, which are more and more frequent during the last three decades. And finally, the last message, albeit the possible benefits of the moderate consumption of fermented alcohol beverages, there are no recommendations to consume alcohol.

Key words:

Moderate consumption of alcohol. Polyphenols. Beer. Microbiota. Health.

Resumen

El consumo moderado de bebidas con alcohol se ha relacionado con ciertas propiedades beneficiosas para la salud en comparación con situaciones de abstinencia o consumo excesivo, revelando una relación con la salud del huésped que es dependiente de la dosis de alcohol. Los componentes de la cerveza más relacionados con beneficios en la salud tras un consumo moderado son los compuestos fenólicos y el alcohol. En concreto, el consumo moderado de cerveza se relaciona con una mayor densidad ósea, principalmente debido a su fracción fenólica. Sus beneficios cardiovasculares e inmunológicos también parecen estar relacionados con el contenido en componentes fenólicos y alcohol, ya que podrían ejercer propiedades antiinflamatorias y antioxidantes.

Cabe destacar el interés por el estudio de la microbiota intestinal en esta área debido a ciertos estudios en los que se han demostrado cambios en la composición de grupos bacterianos tras el consumo de bebidas fermentadas, atribuido a la acción de los compuestos fenólicos en el intestino. Queda por ello abierta una gran área de investigación centrada en los efectos del consumo moderado de cerveza sobre la microbiota intestinal, hasta ahora poco estudiada.

No obstante, es importante enfatizar que el consumo moderado de cerveza tiene que estar incluido en un estilo de vida adecuado para evitar un posible riesgo de desarrollar enfermedades no transmisibles, cada vez más frecuentes durante las tres últimas décadas. Finalmente, a pesar de que se han demostrado posibles beneficios del consumo moderado de las bebidas fermentadas con alcohol, no hay recomendaciones para su consumo.

Palabras clave:

Consumo moderado de alcohol. Polifenoles. Cerveza. Microbiota. Salud.

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BEER HISTORY

In ancient days, beer, made from fermented barley, was used for medicinal purposes but it also had a role in daily life, similarly to wine. It was thought to contain a spirit or a God, exert supernatural effects and both fermented drinks were used in many types of ceremonies, including religious ones. The medicinal uses included those as anaesthetics, stimulants, analgesics, antiseptics, as well as to cleanse wounds, relieve pain, and some others (1).

In the Neolithic times, fermentations were probably initiated by naturally occurring yeasts, and it is still unknown when humans started to consciously add selected yeast to make beer, wine or bread. Such human activities have led to the differentiation of genetically distinct groups within the *S. cerevisiae* species according to the food process origin (2). Pasteur published a study based in scientific evidence that discarded spontaneous generation and added information about beer spoiling microorganisms. Pasteur's studies on wine and beer fermentation together with the detection of facultative anaerobic fermentation of yeast led into the development of microbiology as a nutrition related new discipline and allowed the huge increase in beer production and the development of new types of industrial fermenters (3).

During the final decades of the 19th century, advances were taking place in enzymology and microbiology sciences leading to important consequences in the beer industry, such as reaching lower rates of contamination by unwanted microorganisms (4). Beers from those days were similar in carbohydrate content but could have up to 40-fold higher aldehydes concentration compared to current references.

Recent interest in the study of the yeast domestication for food purposes has led to the knowledge that ale and lager beers, which differ in the fermentation temperature, use also different *Saccharomyces* species. Thus, lager beers are made by using yeast obtained by the genomic combination of different related species of *Saccharomyces* (2).

DEFINITION OF MODERATE ALCOHOL CONSUMPTION

Effects of alcoholic beverage consumption on health are known to be dose-dependent, and although still controversial, it is quite acknowledged that moderate amounts may confer some protective effect upon the risk of suffering certain age-related diseases and the overall mortality rates compared to abstinence (5). However, it is not easy to identify what a moderate amount of alcohol is, since it depends on the final purpose. In general, lower thresholds are admitted when the aim is to establish guidelines for the general population and higher thresholds are used in research studies on the associations of alcohol consumption and morbidity-mortality risk when differentiating low from medium and high-risk drinking (6). In addition, identifying a safe or beneficial alcohol consumption will need to consider not only the average daily dose but also the pattern of consumption, including frequency of consumption in a reference period (regularity of drinking) as well as the number of drinks consumed in a single sitting (6). Regarding beer, the definition of moderate consumption is based on the amount of alcohol it contains, and, as a general rule, it is assumed one drink (330 ml of a 4% w/v alcohol) for women and two drinks for men per day (5).

BEER'S NUTRIENT AND BIOACTIVE COMPONENTS

Four are the essential ingredients for beer brewing, namely barley, hops, yeasts and water. After malting barley and later fermentation with yeast, small amounts of carbohydrates and proteins are still present in the final product and ethanol has been developed. Polyphenol content (flavonoids, phenolic acids, etc) both from hop and barley are relevant in beer; indeed, anti-bacterial, anti-oxidative, anti-proliferative, anti-angiogenic, apoptosis-inducing effects have been described (7). The most unique compounds in beer are the extracts from hops, in particular xanthohumol/isoxanthohumol/8-prenylnaringenin and bitter acids (α-acids humulone/β-acids lupulone), which have potential oestrogenic activity useful in the treatment of menopausal symptoms, osteoporosis and cancer (8,9). Beer also contains significant amounts of fluoride, silicon, choline and folate, so that two cans might provide 10% of RDA for these vitamins and minerals (5).

HEALTH EFFECTS OF MODERATE BEER CONSUMPTION

BONE HEALTH

Several studies have suggested that lifestyle, physical activity, smoking and alcohol intake have an impact on bone density. The fact that alcohol intake is considered an integral part of the culture, social relationship and gastronomy, has made necessary a more in-depth study of alcohol effects on health. Results from studies with excessive doses of alcohol have revealed an impact on bone development by increasing the urinary excretion of calcium. In addition, the alteration in hepatic hydroxylation of vitamin D and decreased production of vitamin D-binding-protein could decrease vitamin D production and also affect calcium metabolism. These effects could lead to osteoporosis development, which is also related to malnutrition, malabsorption and hepatic cirrhosis (10).

In respect to moderate alcohol consumption, opposite findings have been found. Indeed, the Framingham Osteoporosis Study has shown that the consumption of alcohol in a moderate regular basis, mainly in the form of beer or wine, was related to a better femoral bone density as compared to abstemious, both in men and women consumers (11). Specifically, beer consumed in moderate amounts has been related to an increased bone density of the trochanter in old women as compared to abstemious or excessive alcohol consumers (12). Evidence points out that the polyphenolic fraction, as well as flavonoids and the silicon content of beer could account for the positive effects found in bone metabolism, along with its phytoestrogen composition, with a similar structure and function

that the 17-beta estradiol. Several factors have to be considered when considering alcohol intake effects, such as sex, age of onset, frequency of consumption, total amount of alcohol and type of beverage. Hormonal changes also need to be addressed in women, since some studies have revealed an increase in endogenous estrogens production or calcitonin secretion in postmenopausal women after moderate alcohol consumption (13).

CARDIOVASCULAR HEALTH

Low and moderate alcohol consumption has been related to a reduced mortality and morbidity of cardiovascular (CV) diseases. The effects found on CV health are dependent on the type of beverage, since distilled and fermented beverages have a different content in ethanol and non-alcoholic compounds. Regarding moderate beer consumption, several epidemiological studies have revealed that it might protect from coronary diseases, ischemic stroke, peripheral arterial diseases and congestive heart failure development in a dose dependent manner (5).

The protective effects on CV health related to beer consumption have been attributed to both ethanol and polyphenols content (5,14). On the one hand, the polyphenol fraction of beer has been associated to reduced levels of adhesion molecules in leukocytes and plasma inflammatory biomarkers, as well as decreased number of circulating endothelial progenitor cells (EPC), which are considered as a surrogate marker of vascular function and CV risk (15). On the other hand, ethanol content has been linked to a better lipid profile and reduction of atherosclerosis-related biomarkers; all together improving both the immune system and cardiovascular health.

IMMUNOLOGICAL EFFECTS

Epidemiological studies have suggested a relationship between fermented beverages intake in a moderate basis and lower levels of inflammatory biomarkers, mainly attributed to the polyphenol, antioxidant, vitamins and alcohol content (16,17). Moreover, studies performed in healthy subjects consuming a moderate intake of beer have revealed immunomodulatory effects as observed in the increased levels of CD3+ lymphocytes and immunoglobulins (Ig)G, IgM e IgA, in a sex-dependent manner. Indeed, the differences in alcohol metabolization and sensitivity of the nervous and endocrine systems found between men and women could influence sex differences related to beer consumption. In addition, increased levels of cytokines such as interleuquin (IL)-2, IL-4, IL-10 and interferon (IFN)-γ have also been observed in healthy adults (18).

GUT MICROBIOTA CHANGES

There is evidence of chronic alcohol consumption and deleterious effects on the gut microbiota composition. The main effect observed is the development of dysbiosis in both rodents and humans studies (19), showing altered proportions in the dominant bacterial taxa from the *Phyla bacteroidetes* and *Firmicutes* and increase in bacteria from the *Phylum* proteobacteria. Some studies have revealed intestinal hyperpermeability and endotoxemia at the same time that the development of dysbiosis occurs, suggesting that changes in the microbiota may be contributing to the alcohol-induced effects on the intestine, increasing the translocation of gram-negative microbial bacterial products (20).

Evidence focused on beer consumption effects on the gut microbiota composition is scarce, although this field has gained special attention due to relevant findings from several studies suggesting a potential effect of polyphenols in the gut microbiota composition (21). Indeed, the production of short chain fatty acids (SCFA) after polyphenol intake has been suggested as a potential mechanism, which improves intestinal permeability and in turn decrease intestinal inflammation and endotoxemia (21). There is existing evidence from wine interventions regarding gut microbiota changes. Indeed, Queipo-Ortuño's study revealed an immunomodulatory effect of wine intake increasing *Bifidobacterium* levels in healthy subjects, as well as changes in several beneficial butyrate producers such as *Roseburia* and *Faecalibacterium prausnitzii*. In addition, decreases in pathogenic bacteria such as *Escherichia coli* and *Enterobacter cloacae* have been found. The intake of dealcoholized red wine also increased *Bifidobacterium levels,* and *Eubacterium rectale-C. coccoides* group, suggesting that the polyphenol fraction of wine was the responsible of these beneficial changes (22). Furthermore, quercetin modified the Firmicutes/Bacteroidetes ratio and Bacteroidetes levels, while epicatequin and catequin influence the growth of beneficial bacteria such as *Clostridum coccoides* and *Eubacterium Caccae* and limited the growth of the pathogenic bacteria *Clostridium Histolyticum* (23). Therefore, gut microbiota changes after beer consumption could be expected regarding the existing evidence of polyphenols, as mentioned above.

However, it is very important to highlight that the moderate amount of beer must be consumed within an adequate lifestyle in order to avoid possible risks to develop non-communicable diseases, which are more and more frequent during the last three decades (Fig. 1).

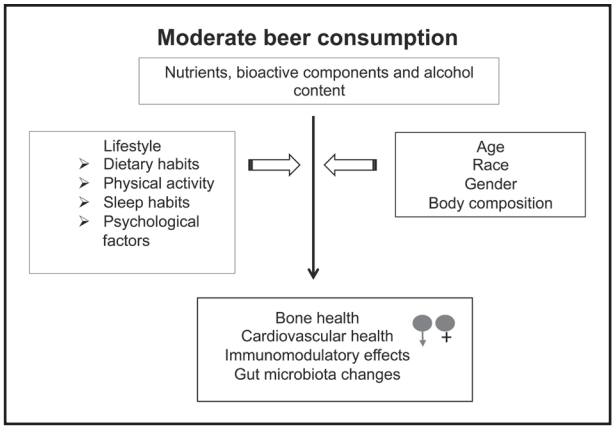

Figure 1.

Relationship between moderate consumption of beer and health.

And finally, the last message, albeit the possible benefits of the moderate consumption of fermented alcohol beverages, is as follows: there are no recommendations to consume alcohol.

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