

Hops (*Humulus lupulus L.*) and Beer: Benefits on the Sleep

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The hop (*Humulus lupulus L.*), a plant used for brewing because of its aromatic characteristics, has also traditionally been used as a soothing agent. Its sedative activity lies mainly in its bitter acids, and in particular in their oxidative degradation products such as that resulting from the α -acid content: 2-methyl-3-buten-2-ol [1]. Other active components such as the flavonoid xanthohumol are added to degradation products such as 2-methyl-3-buten-2-ol [2], and the terpene, myrcenol [3]. The main mechanism of action of hops is to modulate the activity of the neurotransmitter γ -aminobutyric acid (GABA) through modulation of brain GABA(A) receptors [2]. The sedative effect of hops on the nervous system has been widely reported in research using animal models [1,4-7], as also has the narcotic effect at high concentrations due to the 2-methyl-3-buten-ol component [8,9].

Basic research on hops has found effective applications in the healthy human population as an aid to sleep [10,11]. In addition to its use in people with sleep problems, the sedative action associated with the components of hops has been used to correct temporary sleep onset and sleep interruption disorders in human populations with treatments applying a combination of valerian and hops [12,13]. Clinical trials with hops gave satisfactory results as the improvement of sleep quality in patients with insomnia is concerned [14], and in patients suffering from non-organic sleep disorder [15]. Above all, it is also known that both hops and other derivatives of beer can have impact on the inhibitory neurotransmitter GABA(A) [3].

In addition to the central nervous effects of hops as far as GABAergic neurotransmission is concerned, hops does also affect serotonin (5-HT), a further neurotransmitter involved in nocturnal sleep regulation [16]. Moreover, 5-HT is involved as regards the activation of the hormone melatonin, an endocrine agent that entrains circadian rhythms [16-18]. There are also effects of hops on the neuronal receptors of adenosine which are extensively involved in the mechanism of sleep [19]. Therefore, beer and its hop component are thought to enhance the CNS's neuroendocrine response via GABA, adenosine, and the biogenic amines serotonin and melatonin [20] with an effective sedative action that both modulates the sleep/wake rhythm and favours the induction of sleep [21-23].

In general, there is an initial rejection of the notion that beer may be linked to health because it is a drink that is presumed to cause overweight. However, the caloric content of normal beer is 45 kcal per 100 ml. The caloric content of non-alcoholic beer, which was used in the present study, was relatively low with 17 kcal per 100 ml. Research indicated that moderate daily ingestion of a one-third of a litre tin of beer in women and two tins in men did not produce any significant change in weight [24,25].

In fact, some properties of beer are thought to have a positive impact on human health. These are thought to be due to the effects of certain components, as for example the aforementioned flavonoid xanthohumol. This compound in particular is thought to fight and prevent cancer as it inhibits the metabolic activation of procarcinogens, induces the activation of anti-cancerigenous enzymes, and inhibits tumour growth in early stages [26,27]. Other actions of this particular flavonoid include its effective anti-inflammatory effect in inhibiting prostaglandin synthesis via the cyclooxygenases COX-1 and COX-2. Moreover its suppression of the expression of nitric oxide synthase (NOS) whose prolonged activation can trigger the production of vascular endothelial

growth factor (VEGF) has been reported [28]. A further property is its antioxidant activity since in vitro xanthohumol has been found more effective than α -tocopherol. Finally a decrease in the tissue damage risk marker, the amino acid homocysteine (HCY), was found. As regards the effects of moderate beer intake major anti-arteriosclerotic, anti-inflammatory, and anti-thrombotic effects have been reported [29].

A further component of beer is 8-prenylnaringenin, a phytoestrogen that acts beneficially on bone metabolism, increasing bone density in adults (both men and postmenopausal women), and is thus helpful in preventing or mitigating osteoporosis [30-33]. Beer can also act as an immuno modulator in healthy populations through an increase in leukocytes and T-lymphocyte subpopulations, with this effect being stronger in females than in males, and beer was also shown to be involved in the production of certain cytokines (IL-2,-4,-6,-10; IFN- γ ; and TNF- α) and antibodies [24,25]. The β -bitter acids of the hops, together with myrcenol and xanthohumol, give beer its sedative effect, with their capacity to entrain circadian rhythms, favouring the induction of sleep.

Overall, there are components in beer that are thought to be beneficial to health, and some authors consider that some properties of beer could make it a candidate for possible use as a nutraceutical compound.

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