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Review

Review on Betalains- Anti-Inflammatory activity



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	Abstract
Published on: 07 Mar 2024	<p>Certain kinds of Caryophyllales plants and several higher-order fungi have betalains, which are naturally occurring colors based on nitrogen. Betalains are separated into betacyanins, which are red, and betaxanthins, which are yellow. It is commonly recognized that betalains have positive health effects and have a great capacity to scavenge free radicals, fight cancer, and prevent certain types of cancer. These characteristics open a recently popularized field of study: anti-inflammatory research. The significant potential of betalains as natural anti-inflammatory agents has been shown through in vitro, in vivo, and clinical investigations, leading to the conclusion that betalains have a good potential to promote health and can be utilized as an adjuvant therapy. Although the primary source of betalains is red beetroot, additional sources, such as cactus plants, should be researched. The study on the anti-inflammatory effects of betalains is summarized in this article. The accumulating data indicates that a thorough investigation of betalains' anti-inflammatory properties is required.</p>
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INTRODUCTION

Natural chemicals have been employed extensively in recent years due to their advantageous qualities, and study on these substances has drawn attention from all around the world. Investigations on these substances' antioxidant, anti-diabetic, cytotoxic, or antibacterial properties have been carried out over time; however, investigations on their anti-inflammatory properties open a new area of study for natural compounds. Betalains are a type of natural pigment that are frequently shown to have advantageous qualities. Due to their widespread global harvest, beetroots are the primary and most popular source of betalains. Pitahaya (*Hylocereus* spp.), prickly pear (*Opuntia* spp.), amaranthus (*Amaranthaceae* spp.), and, less well-studied, the fruits of the "garambullo" cactus (*Myrtillocactus geometrizans*), an endemic plant of Mexico with high amounts of betalains, are additional

sources of betalains that can be consumed. The majority of studies on the anti-inflammatory properties of betalains discuss an extract or a pigment (betalain purified).

Betalain source	Extract/Bioactive compound	Subject	Dose	Mechanism
Beetroot	Commercially juice	Stimulated and unstimulated peripheral blood mononuclear cells	1–5% of juice	Decrease of inflammatory agents
Beetroot	Pure betanin	Tumor cell lines	12.5, 25, 50, 100 and 200 g/mL	Inhibition of the COX-1 and 2
Beetroot	Betalains rich-extract	Osteoarthritis patients	35–100 mg	Decrease of inflammatory agents
Beetroot	Beetroot ethanolic extract	Rat model	250–500 mg/kg	Decrease of inflammatory agents
Beetroot	Raw beet juice and cooked beet	Hypertensive patients	250 mL/day and 250 g/day	Decrease of inflammatory agents
Beetroot	Betalains dye	Rat model	10–1000 mg/kg	Decrease of inflammatory agents

Red beet extract (*Beta vulgaris* L.) has been shown to have betalains' anti-inflammatory properties in OA patients. Red beet extract (RBE) enriched in total betalains up to 25% was administered twice daily for exactly ten days to participants with active OA symptoms, and sera from volunteers were submitted to cytokine and chemokine arrays. Ten days of RBE treatment resulted in a time- and dose-dependent decrease in McGill ratings (a pain scoring system), with a maximum drop of 33% from the first day of treatment.

It's interesting to note that in participants whose blood TNF- levels were higher than 1 pg/mL prior to the treatment, serum TNF- levels were decreased as a result of the treatment. It was also found that serum levels of AOPP (proteins oxidized by hypochlorous acid/hypochlorites and a pro-inflammatory factor) were reduced by up to 48% after ten days of treatment; additionally, RBE reduced the blood levels of IL-6, RANTES, and GRO-alpha. According to this study, consuming RBE at recommended dosages may reduce discomfort brought on by OA conditions. This is because RBE contains betalains, which may prevent protein oxidation brought on by hypochlorous acid generated from active neutrophils. In chronic inflammatory bowel disease (IBD), indicaxanthin has been shown to have anti-inflammatory properties. An in vitro intestinal inflammation model using IL-1-activated Caco-2 cell monolayers showed evidence of an anti-inflammatory activity from indicaxanthin derived from edible thorn pear fruit (*Opuntia ficus-indica*, L.). A cytokine called IL-1 is recognized to be very important in starting and escalating inflammation in IBD. When Caco-2 cells were exposed to IL-1, NADPH oxidase (NOX-1) was activated, creating reactive oxygen species (ROS), which then activated an intracellular signaling cascade, activating NF-B, causing pro-inflammatory mediators and inflammatory enzyme upregulation. Researchers looked at betanin's impact on inflammation and oxidative stress in the rats' kidneys after paraquat treatment. Betanin was given to rats that had been given paraquat three days before and two days after the paraquat treatment. After being exposed to paraquat, the rats in the paraquat group developed anorexia, weakness, withering, and weight loss. Betanin significantly reduced these symptoms, especially at the highest tested concentration. Histological analysis revealed significant renal damage; however, betanin treatment preserved some kidney structures and reduced bleeding, showing that betanin can shield against damage brought on by paraquat. Additionally, betanin decreased the kidney's oxidative stress from paraquat as well as the levels of the proteins iNOS, COX-2, and NF-B. Beet juice and boiling beetroot consumption lowers endothelial dysfunction and systemic inflammatory biomarkers in hypertensive individuals [36]. Numerous processes, including the squelching of reactive oxygen species, the overexpression of antioxidant enzymes and NO production, and the down regulation of inflammatory mediators, are responsible for these benefits. Because beetroot juice has positive effects on vascular endothelial function, inflammation, and oxidative state, it can be utilized as an adjuvant therapy for hypertension, especially in its raw form.

The total betalain and total flavonoid contents exhibited an association with this anti-inflammatory effect; nevertheless, further research into the pathway of this inhibition is necessary.

CONCLUSION

Betalains have shown that they can lower inflammatory indicators like TNF-, IL-1, or NF-B, as well as protect against harm from xenobiotics like paraquat and quench chemicals made by reactive oxygen species. These results imply that betalains may have broader therapeutic uses. Betalains also had strong health-promoting potential and held promise for application in a variety of disorders, including hypertension, as an adjuvant therapy. The positive outcomes of betalains' anti-inflammatory activity create a new area for ongoing investigation into how betalains can lessen anti-inflammatory activity. Other sources of betalains, such as the Amaranthaceae family or endemic species of cacti, including *Myrtillocactus geometrizans*, have not yet been investigated. Finally, there is still much to learn about how betalains function in the inflammatory process pathways.

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