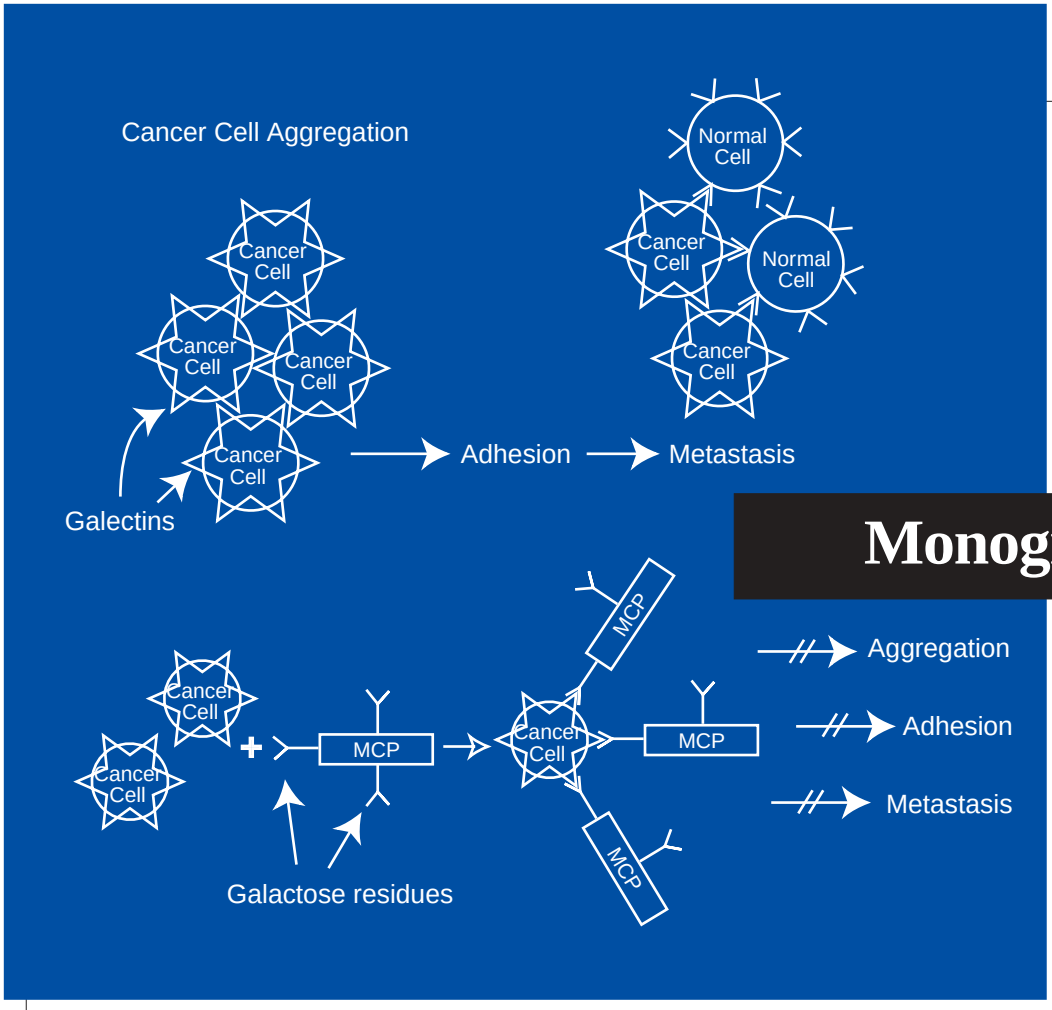

Monograph

Modified Citrus Pectin

Introduction

Modified citrus pectin (MCP), also known as fractionated pectin, is a complex polysaccharide obtained from the peel and pulp of citrus fruits. Modified citrus pectin is rich in galactoside residues, giving it an affinity for certain types of cancer cells. Metastasis is one of the most life-threatening aspects of cancer and the lack of effective anti-metastatic therapies has prompted research on MCP's effectiveness in blocking metastasis of certain types of cancers, including melanomas, prostate, and breast cancers.

Chemistry

Modified citrus pectin powder is produced from citrus pectin via pH and temperature modification that breaks it into shorter, non-branched, galactose-rich, carbohydrate chains. These shorter chains dissolve more readily in water and are better absorbed and utilized by the body than ordinary, long-chain pectins. It is believed the shorter polysaccharide units afford MCP its ability to access and bind tightly to galactose-binding lectins (galectins) on the surface of certain types of cancer cells.[1]

Mechanism of Action

Research indicates that in order for metastasis to occur, cancerous cells must first clump together; galectins on their surface are thought to be responsible for much of this metastatic potential. Galactose-rich, modified citrus pectin has a binding affinity for galectins on the surface of cancer cells, resulting in an inhibition, or blocking, of cancer cell aggregation, adhesion, and metastasis.[1,2] Due to the life-threatening nature of metastatic cancer, most research on anti-metastatic therapies has

either been in *in vitro* cell cultures or in animal studies. Although it is still unclear exactly how these study results translate to humans, MCP studies are promising.[3]

Clinical Indications

Prostate Cancer

Pienta et al examined modified citrus pectin's effectiveness against prostate cancer metastasis in the Dunning rat model. Rats were injected with prostate adenocarcinoma cell lines and given drinking water containing various MCP concentrations. Oral MCP did not affect primary tumor growth, but significantly reduced metastases when compared to control animals.[4] In one human study, Strum et al examined the effect of MCP on prostate specific antigen (PSA) doubling time in seven prostate cancer patients. PSA is an enzymatic tumor marker, and its doubling time reflects the speed at which the cancer is growing. Modified citrus pectin was administered orally at a dosage of 15 grams per day in three divided doses. Four of seven patients exhibited more than 30-percent lengthening of PSA doubling time. Lengthening of the doubling time represents a decrease in the cancer growth rate.[1]

Breast Cancer

As with prostate adenocarcinoma, research demonstrates metastasis of breast cancer cell lines requires aggregation and adhesion of the cancerous cells to tissue endothelium in order for it to invade neighboring tissue.[5] The anti-adhesive properties of modified citrus pectin were studied in an *in vitro* model utilizing breast carcinoma cell lines MCF-7 and T-47D. MCP blocked the adhesion of malignant cells to blood vessel endothelia, thus inhibiting metastasis.[6] A more recent human study examined galectin expression in 27 patients with invasive breast cancer. The study revealed that increasing histologic grades of breast cancer exhibited a decrease in galectin-3 expression, possibly resulting in increased cancer cell motility and metastasis.[7]

Melanoma

One of the better animal models for studying metastasis is the highly metastatic mouse B16-F1 melanoma. Using this system Platt and Raz determined that MCP significantly decreased tumor metastasis to the lung by more than 90 percent. In comparison, regular citrus pectin administration resulted in a significant increase (up to three-fold) in tumor metastases. The researchers concluded MCP's interference in the metastatic process might lead to a reduced ability to form tumor cell aggregates and metastases.[8]

Safety and Side Effects

Because it is a soluble fiber, administration of modified citrus pectin is unlikely to result in gastric intolerance, even at high doses. No pattern of adverse reaction has been recorded in the scientific literature. As with any dietary fiber, MCP at high doses may result in mild cases of loose stool, but this is usually self-limiting and does not warrant discontinuing treatment.

Dosage and Administration

Modified citrus pectin dosages are usually expressed in grams, with a typical adult dosage ranging between 6-30 grams daily in divided doses. This may be modified by the practitioner depending on the patient's clinical status, type of cancer involved, and degree of metastasis. The MCP powder is usually dissolved by blending in a small amount of water, then diluting with a juice of choice.

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