

Trametes Versicolor

Bioactive Compounds

Turkey Tail Mushroom

Polysaccharides

1. Polysaccharide Peptide (PSP)

- **Immune Modulation:**
 - **Activation of Immune Cells:** PSP can bind to receptors on various immune cells, including macrophages, dendritic cells, natural killer (NK) cells, and T cells. This binding triggers their activation, enhancing their ability to recognize and respond to threats.
 - **Cytokine Regulation:** PSP influences the production of cytokines, which are signaling molecules that help coordinate immune responses. It can promote the release of certain cytokines that are important for fighting infections and cancer, while also helping to regulate inflammation.
 - **Enhanced Phagocytosis:** PSP can boost phagocytosis, the process by which immune cells engulf and destroy pathogens or other foreign invaders.
 - **Increased NK Cell Activity:** NK cells are crucial for killing infected cells and cancer cells. PSP can stimulate their activity, making them more effective at targeting and eliminating these threats.
- **Anti-cancer Effects:**
 - **Immune-Mediated Anti-cancer Activity:** By strengthening the immune system, PSP indirectly contributes to anti-cancer defense. A more robust immune system is better equipped to recognize and destroy cancer cells.
 - **Potential Direct Anti-tumor Effects:** Some research suggests that PSP may have direct anti-tumor activity, possibly by interfering with cancer cell growth and division. However, more research is needed to confirm these findings.
- **Gut Health:**
 - **Prebiotic Effects:** Like other polysaccharides, PSP can act as a prebiotic, nourishing beneficial bacteria in the gut. A healthy gut microbiome is essential for digestion, immune function, and overall well-being.
 - **Microbiome Modulation:** PSP may help improve the diversity and balance of the gut microbiome, which is increasingly recognized as important for various aspects of health.



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- **4. Antioxidant Effects:**

- **Scavenging Free Radicals:** Some studies indicate that PSP exhibits antioxidant activity, helping to neutralize harmful free radicals and protect cells from oxidative damage.

2. Polysaccharide Krestin (PSK)

- **Immune Modulation:**

- **Activation of Immune Cells:** PSK interacts with various immune cells, including macrophages, dendritic cells, natural killer (NK) cells, and T cells. It binds to receptors on these cells, triggering their activation and enhancing their ability to recognize and respond to threats.
- **Cytokine Regulation:** PSK influences the production of cytokines, which are signaling molecules that help coordinate immune responses. It can stimulate the release of cytokines that are important for fighting infections and cancer, while also helping to regulate inflammation.
- **Enhanced Phagocytosis:** PSK can boost phagocytosis, the process by which immune cells engulf and destroy pathogens or other foreign invaders.
- **Increased NK Cell Activity:** NK cells are crucial for killing infected cells and cancer cells. PSK can stimulate their activity, making them more effective at targeting and eliminating these threats.
- **Modulation of TLRs:** PSK interacts with Toll-like receptors (TLRs) on immune cells. TLRs are involved in recognizing pathogens and triggering immune responses. By modulating TLR signaling, PSK can fine-tune the immune response.

- **Anti-cancer Effects:**

- **Immune-Mediated Anti-cancer Activity:** By strengthening the immune system, PSK indirectly contributes to anti-cancer defense. A more robust immune system is better equipped to recognize and destroy cancer cells.
- **Potential Direct Anti-tumor Effects:** Some research suggests that PSK may have direct anti-tumor activity, possibly by interfering with cancer cell growth and division. However, more research is needed to fully understand these mechanisms.
- **Reduction of Cancer Treatment Side Effects:** PSK has been shown to help reduce some side effects of chemotherapy, such as nausea, vomiting, and low white blood cell counts, potentially improving quality of life for cancer patients.



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- **Gut Health:**
 - **Prebiotic Effects:** Like other polysaccharides, PSK can act as a prebiotic, nourishing beneficial bacteria in the gut. A healthy gut microbiome is essential for digestion, immune function, and overall well-being.
 - **Microbiome Modulation:** PSK may help improve the diversity and balance of the gut microbiome, which is increasingly recognized as important for various aspects of health.
- **Antioxidant Effects:**
 - **Scavenging Free Radicals:** Some studies indicate that PSK exhibits antioxidant activity, helping to neutralize harmful free radicals and protect cells from oxidative damage.
- **Important Considerations:**
 - **Extensive Research:** PSK is one of the most well-studied polysaccharides from medicinal mushrooms, with a significant body of research supporting its immune-modulating and anti-cancer effects.
 - **Clinical Use:** In some Asian countries, PSK is approved as an adjunct to cancer treatment, highlighting its recognized therapeutic potential.
 - **Standardization:** The composition and concentration of PSK can vary depending on factors like the strain of turkey tail, growing conditions, and extraction methods. This can make it challenging to standardize PSK products.
 - **Synergistic Effects:** PSK likely works in synergy with other bioactive compounds in turkey tail, such as other polysaccharides and triterpenoids, to produce the overall health benefits.



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Triterpenoids

1. Trametesan A

- **Anti-cancer Effects:**
 - **Direct Anti-tumor Activity:** Some triterpenoids, like Trametesan A, have shown direct anti-tumor activity in laboratory studies, inhibiting the growth and spread of cancer cells through various mechanisms.
 - **Apoptosis Induction:** They may induce apoptosis (programmed cell death) in cancer cells, causing them to self-destruct.
 - **Anti-angiogenic Effects:** Some triterpenoids may have anti-angiogenic properties, meaning they can inhibit the formation of new blood vessels that tumors need to grow and spread.

2. Ganoderic acids:

- **Anti-inflammatory**
 - **Inhibiting inflammatory pathways:** Ganoderic acids can suppress the activation of key inflammatory pathways, such as NF- κ B (Nuclear Factor-kappa B) and MAPK (Mitogen-Activated Protein Kinase) pathways.
 - **Reducing cytokine production:** They can also help to reduce the production of inflammatory cytokines, such as TNF-alpha, IL-1, and IL-6.
- **Antioxidant**
 - **Free radical scavenging:** Some ganoderic acids can directly scavenge free radicals, protecting cells from oxidative damage.
 - **Enhancing antioxidant enzymes:** They may also stimulate the production of antioxidant enzymes, such as superoxide dismutase (SOD) and catalase, which help to neutralize free radicals.



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3. Sterols

- **Ergosterol:** Upon exposure to ultraviolet (UV) light, ergosterol undergoes photoconversion into vitamin D2 (ergocalciferol).
- **Lanosterol:** is a tetracyclic triterpenoid and is the compound from which all animal and fungal steroids are derived. By contrast, plant steroids are produced via cycloartenol.^[1] In the eyes of vertebrates, lanosterol is a natural constituent, having a role in maintaining the health of the lens. Lanosterol is the precursor to cholesterol.

4. Phenolics:

Protocatechuic Acid:

- **Antioxidant:**
 - **Free radical scavenging:** Directly neutralizes reactive oxygen species (ROS) such as superoxide, hydroxyl, and peroxy radicals.
 - **Chelating metal ions:** Can chelate metal ions like iron and copper, which can catalyze the formation of harmful free radicals.
- **Anti-inflammatory:**
 - **Inhibition of inflammatory mediators:** Can inhibit the production of pro-inflammatory cytokines (like TNF- α , IL-1 β) and enzymes (like cyclooxygenase and lipoxygenase).
 - **Modulation of pathways:** Interferes signaling pathways involved in inflammation.

Vanillic Acid:

- **Antioxidant:**
 - **Free radical scavenging:** Directly neutralizes reactive oxygen species (ROS) such as superoxide, hydroxyl, and peroxy radicals.
 - **Chelating metal ions:** Can chelate metal ions like iron and copper, which can catalyze the formation of harmful free radicals.
- **Anti-inflammatory:**
 - **Inhibition of inflammatory mediators:** Can inhibit the production of pro-inflammatory cytokines (like TNF- α , IL-1 β) and enzymes (like cyclooxygenase).
- **Antimicrobial:** May exhibit antimicrobial activity against certain bacteria and fungi.



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Gallic Acid:

- **Antioxidant:**
 - **Free radical scavenging:** A very effective scavenger of various free radicals, including hydroxyl radicals and superoxide.
 - **Metal chelation:** Strong metal chelating ability, reducing the availability of metal ions that can catalyze oxidative damage.
- **Anti-inflammatory:**
 - **Inhibition of inflammatory mediators:** Can inhibit the production of pro-inflammatory cytokines and enzymes.
 - **Antimicrobial:** Exhibits antimicrobial activity against a range of microorganisms.

Quercetin:

- **Antioxidant Effects:**
 - **Free Radical Scavenging:** Quercetin is a potent antioxidant that can directly scavenge a variety of free radicals, including reactive oxygen species (ROS) and reactive nitrogen species (RNS). It donates electrons or hydrogen atoms to neutralize these harmful molecules, preventing them from damaging cellular components like DNA, lipids, and proteins.
 - **Boosting Antioxidant Enzymes:** Quercetin can also induce the expression and activity of endogenous antioxidant enzymes, such as superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx). These enzymes are crucial for the body's defense against oxidative stress, further contributing to quercetin's protective effects.
 - **Chelation of Metal Ions:** Quercetin can chelate metal ions, such as iron and copper, which can otherwise catalyze the formation of free radicals. By binding to these metal ions, quercetin prevents them from participating in redox reactions that generate harmful free radicals.
- **Anti-inflammatory Effects:**
 - **Inhibition of Pro-inflammatory Cytokines:** Quercetin can suppress the production of pro-inflammatory cytokines, such as TNF- α , IL-1 β , and IL-6. These cytokines play a key role in orchestrating inflammatory responses, and by reducing their levels, quercetin can help dampen inflammation.
 - **Modulation of Inflammatory Pathways:** Quercetin can interfere with various signaling pathways involved in inflammation, such as the NF- κ B pathway and the MAPK pathway. By modulating these pathways, quercetin can reduce the expression of pro-inflammatory genes and the production of inflammatory mediators.



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- **Inhibition of Inflammatory Enzymes:** Quercetin can inhibit the activity of enzymes involved in the inflammatory cascade, such as cyclooxygenase-2 (COX-2) and lipoxygenase (LOX). These enzymes produce prostaglandins and leukotrienes, respectively, which are inflammatory mediators.
- **Anti-cancer Effects:**
 - **Induction of Apoptosis:** Quercetin can induce apoptosis (programmed cell death) in cancer cells through various mechanisms, such as activating caspases and disrupting mitochondrial function. This selective killing of cancer cells is a crucial aspect of its anti-cancer potential.
 - **Inhibition of Cell Proliferation:** Quercetin can inhibit the proliferation of cancer cells by interfering with cell cycle progression and blocking the signals that promote cell growth.
 - **Anti-angiogenic Effects:** Quercetin may have anti-angiogenic properties, meaning it can inhibit the formation of new blood vessels that tumors need to grow and spread. By cutting off the blood supply to tumors, quercetin can slow down their growth and metastasis.
 - **Inhibition of Metastasis:** Quercetin may also inhibit the metastasis (spread) of cancer cells by interfering with the processes that allow cancer cells to invade surrounding tissues and migrate to distant sites.
- **Cardiovascular Effects:**
 - **Vasorelaxation:** Quercetin can promote vasorelaxation, meaning it can help relax blood vessels, which can contribute to lower blood pressure and improved blood flow.
 - **Anti-atherosclerotic Effects:** Quercetin may help prevent the development of atherosclerosis (plaque buildup in arteries) by reducing inflammation, inhibiting LDL oxidation, and improving endothelial function (the health of the inner lining of blood vessels).
- **Neuroprotective Effects:**
 - **Protection Against Oxidative Stress:** Quercetin's antioxidant properties can help protect brain cells from damage caused by oxidative stress, which is implicated in neurodegenerative diseases.
 - **Anti-inflammatory Effects:** By reducing inflammation in the brain, quercetin may help protect against neuroinflammation, which is also a contributing factor to neurodegenerative diseases.



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- **Anti-allergic Effects:**

- **Inhibition of Histamine Release:** Quercetin can stabilize mast cells, which are immune cells involved in allergic reactions, and inhibit the release of histamine and other inflammatory mediators that trigger allergy symptoms.

Baicalein:

- **Antioxidant**

- **Free Radical Scavenging:** Baicalein is a potent antioxidant that can scavenge various free radicals, including reactive oxygen species (ROS) like superoxide and hydroxyl radicals. It donates electrons or hydrogen atoms to neutralize these harmful molecules, preventing them from damaging cellular components like DNA, lipids, and proteins.
- **Boosting Antioxidant Enzymes:** Baicalein can also enhance the activity of endogenous antioxidant enzymes, such as superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx). These enzymes are crucial for the body's defense against oxidative stress, further contributing to baicalein's protective effects.

- **Modulating Immune Responses:**

- **Inhibition of Pro-inflammatory Cytokines:** Baicalein can suppress the production of pro-inflammatory cytokines, such as TNF- α , IL-1 β , and IL-6. These cytokines play a key role in orchestrating inflammatory responses, and by reducing their levels, baicalein can help dampen inflammation.
- **Regulation of Immune Cell Activity:** Baicalein can influence the activity of various immune cells, including macrophages, T cells, and B cells. It may modulate their activation, proliferation, and cytokine production, contributing to a balanced immune response. For example, it has been shown to inhibit the activation of NF- κ B, a transcription factor that plays a crucial role in immune and inflammatory responses.
- **Modulation of TLR4 Signaling:** Baicalein can interact with Toll-like receptor 4 (TLR4), a key receptor involved in the innate immune response, and modulate its signaling. This modulation can affect the production of cytokines and other inflammatory mediators.

- **Protecting Against Inflammation:**

- **Inhibition of Inflammatory Enzymes:** Baicalein can inhibit the activity of enzymes involved in the inflammatory cascade, such as cyclooxygenase-2 (COX-2) and lipoxygenase (LOX). These enzymes produce prostaglandins and leukotrienes, respectively, which are inflammatory mediators.
- **Reduction of Inflammatory Mediators:** By inhibiting these enzymes and suppressing pro-inflammatory cytokines, baicalein can reduce the overall production of inflammatory mediators, contributing to its anti-inflammatory effects.



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Kaempferol

- **Antioxidant Effects:**
 - **Free Radical Scavenging:** Kaempferol is a potent antioxidant that can directly scavenge various free radicals, including reactive oxygen species (ROS) and reactive nitrogen species (RNS). It donates electrons or hydrogen atoms to neutralize these harmful molecules, preventing them from damaging cellular components like DNA, lipids, and proteins.
 - **Boosting Antioxidant Enzymes:** Kaempferol can also induce the expression and activity of endogenous antioxidant enzymes, such as superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx). These enzymes are crucial for the body's defense against oxidative stress, further contributing to kaempferol's protective effects.
 - **Chelation of Metal Ions:** Kaempferol can chelate metal ions, such as iron and copper, which can otherwise catalyze the formation of free radicals. By binding to these metal ions, kaempferol prevents them from participating in redox reactions that generate harmful free radicals.
- **Anti-inflammatory Effects:**
 - **Inhibition of Pro-inflammatory Cytokines:** Kaempferol can suppress the production of pro-inflammatory cytokines, such as TNF- α , IL-1 β , and IL-6. These cytokines play a key role in orchestrating inflammatory responses, and by reducing their levels, kaempferol can help dampen inflammation.
 - **Modulation of Inflammatory Pathways:** Kaempferol can interfere with various signaling pathways involved in inflammation, such as the NF- κ B pathway and the MAPK pathway. By modulating these pathways, kaempferol can reduce the expression of pro-inflammatory genes and the production of inflammatory mediators.
 - **Inhibition of Inflammatory Enzymes:** Kaempferol can inhibit the activity of enzymes involved in the inflammatory cascade, such as cyclooxygenase-2 (COX-2) and lipoxygenase (LOX). These enzymes produce prostaglandins and leukotrienes, respectively, which are inflammatory mediators.
- **Anti-cancer Effects:**
 - **Induction of Apoptosis:** Kaempferol can induce apoptosis (programmed cell death) in cancer cells through various mechanisms, such as activating caspases and disrupting mitochondrial function. This selective killing of cancer cells is a crucial aspect of its anti-cancer potential.



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- **Inhibition of Cell Proliferation:** Kaempferol can inhibit the proliferation of cancer cells by interfering with cell cycle progression and blocking the signals that promote cell growth.
- **Anti-angiogenic Effects:** Kaempferol may have anti-angiogenic properties, meaning it can inhibit the formation of new blood vessels that tumors need to grow and spread. By cutting off the blood supply to tumors, kaempferol can slow down their growth and metastasis.
- **Inhibition of Metastasis:** Kaempferol may also inhibit the metastasis (spread) of cancer cells by interfering with the processes that allow cancer cells to invade surrounding tissues and migrate to distant sites.
- **4. Cardiovascular Effects:**
 - **Vasorelaxation:** Kaempferol can promote vasorelaxation, meaning it can help relax blood vessels, which can contribute to lower blood pressure and improved blood flow.
 - **Anti-atherosclerotic Effects:** Kaempferol may help prevent the development of atherosclerosis (plaque buildup in arteries) by reducing inflammation, inhibiting LDL oxidation, and improving endothelial function (the health of the inner lining of blood vessels).
- **5. Neuroprotective Effects:**
 - **Protection Against Oxidative Stress:** Kaempferol's antioxidant properties can help protect brain cells from damage caused by oxidative stress, which is implicated in neurodegenerative diseases.
 - **Anti-inflammatory Effects:** By reducing inflammation in the brain, kaempferol may help protect against neuroinflammation, which is also a contributing factor to neurodegenerative diseases.

Rutin

- **Antioxidant Effects:**
 - **Free Radical Scavenging:** Rutin is a potent antioxidant that can directly scavenge various free radicals, including reactive oxygen species (ROS) and reactive nitrogen species (RNS). It donates electrons or hydrogen atoms to neutralize these harmful molecules, preventing them from damaging cellular components like DNA, lipids, and proteins.
 - **Boosting Antioxidant Enzymes:** Rutin can also enhance the activity of endogenous antioxidant enzymes, such as superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx). These enzymes are crucial for the body's defense against oxidative stress, further contributing to rutin's protective effects.



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- **Chelation of Metal Ions:** Rutin can chelate metal ions, such as iron and copper, which can otherwise catalyze the formation of free radicals. By binding to these metal ions, rutin prevents them from participating in redox reactions that generate harmful free radicals.
- **Anti-inflammatory Effects:**
 - **Inhibition of Pro-inflammatory Cytokines:** Rutin can suppress the production of pro-inflammatory cytokines, such as TNF- α , IL-1 β , and IL-6. These cytokines play a key role in orchestrating inflammatory responses, and by reducing their levels, rutin can help dampen inflammation.
 - **Modulation of Inflammatory Pathways:** Rutin can interfere with various signaling pathways involved in inflammation, such as the NF- κ B pathway and the MAPK pathway. By modulating these pathways, rutin can reduce the expression of pro-inflammatory genes and the production of inflammatory mediators.
 - **Inhibition of Inflammatory Enzymes:** Rutin can inhibit the activity of enzymes involved in the inflammatory cascade, such as cyclooxygenase-2 (COX-2) and lipoxygenase (LOX). These enzymes produce prostaglandins and leukotrienes, respectively, which are inflammatory mediators.
- **Cardiovascular Effects:**
 - **Vasorelaxation:** Rutin can promote vasorelaxation, meaning it can help relax blood vessels, which can contribute to lower blood pressure and improved blood flow.
 - **Anti-atherosclerotic Effects:** Rutin may help prevent the development of atherosclerosis (plaque buildup in arteries) by reducing inflammation, inhibiting LDL oxidation, and improving endothelial function (the health of the inner lining of blood vessels).
 - **Strengthening Blood Vessels:** Rutin can strengthen capillaries and blood vessels by promoting the integrity of the endothelial cells that line their interior surface. This can be particularly beneficial for conditions like varicose veins and chronic venous insufficiency.
 - **Inhibition of Platelet Aggregation:** Rutin can inhibit platelet aggregation, reducing the risk of blood clots. This can help protect against conditions like deep vein thrombosis and some forms of heart disease.
- **Neuroprotective Effects:**
 - **Protection Against Oxidative Stress:** Rutin's antioxidant properties can help protect brain cells from damage caused by oxidative stress, which is implicated in neurodegenerative diseases.



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- **Anti-inflammatory Effects:** By reducing inflammation in the brain, rutin may help protect against neuroinflammation, which is also a contributing factor to neurodegenerative diseases.
- **Modulation of Neurotransmitters:** Some studies suggest that rutin may influence levels of certain neurotransmitters in the brain, which could have implications for cognitive function and mood regulation.
- **Other Potential Benefits:**
 - **Anti-cancer Effects:** Some research suggests that rutin may have anti-cancer properties, including the ability to induce apoptosis (programmed cell death) in cancer cells and inhibit their proliferation. However, more research is needed to fully understand its role in cancer prevention and treatment.
 - **Anti-diabetic Effects:** Rutin may have potential benefits for managing diabetes by improving insulin sensitivity and glucose metabolism. However, more studies are needed to confirm these effects.

Amino acids

Ergothioneine:

- **Antioxidant Effects:**
 - **Direct Free Radical Scavenging:** EGT is a potent antioxidant that can directly scavenge various free radicals, including reactive oxygen species (ROS) and reactive nitrogen species (RNS). It donates electrons or hydrogen atoms to neutralize these harmful molecules, preventing them from damaging cellular components like DNA, lipids, and proteins.
 - **Redox Cycling and Regeneration of Other Antioxidants:** EGT can participate in redox cycling so it can be oxidized and then regenerated back to its reduced form. This allows it to continue scavenging free radicals and provide sustained antioxidant protection. It can also help regenerate other antioxidants, such as glutathione, further boosting the body's antioxidant defenses.
 - **Cellular Protection:** EGT has been shown to accumulate in cells, particularly in mitochondria (the cell's powerhouses) and the nucleus (where DNA is stored), suggesting that it may provide targeted antioxidant protection in these crucial cellular compartments.



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- **Anti-inflammatory Effects:**
 - **Modulation of Inflammatory Pathways:** EGT may help reduce inflammation by interfering with key signaling pathways involved in the inflammatory response, such as the NF- κ B pathway. By modulating these pathways, EGT can reduce the expression of pro-inflammatory genes and the production of inflammatory mediators.
 - **Inhibition of Pro-inflammatory Cytokines:** EGT may suppress the production of pro-inflammatory cytokines, such as TNF- α , IL-1 β , and IL-6. These cytokines play a key role in orchestrating inflammatory responses, and by reducing their levels, EGT can help dampen inflammation.
- **Cytoprotective Effects:**
 - **Cellular Defense:** EGT has been shown to protect cells from various stressors, including oxidative stress, inflammation, and toxins. It may enhance cell survival and resilience in the face of these challenges.
 - **Mitochondrial Health:** EGT may play a role in maintaining mitochondrial health and function. Mitochondria are essential for producing energy in cells, and their dysfunction is implicated in various diseases.
- **Potential Benefits for Specific Conditions:**
 - **Neuroprotection:** EGT's antioxidant and anti-inflammatory properties may contribute to neuroprotective effects, potentially reducing the risk of neurodegenerative diseases. Some studies have suggested a link between higher EGT levels and a reduced risk of cognitive decline.
 - **Cardiovascular Health:** EGT may have potential benefits for cardiovascular health by reducing oxidative stress, and inflammation, and improving endothelial function (the health of the inner lining of blood vessels).
 - **Eye Health:** EGT is concentrated in the lens of the eye, where it may help protect against oxidative damage and age-related eye diseases like cataracts.

