PreScouter

Extending Shelf Life: Novel Packaging

Research Support Service

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PRESCOUTER

Intelligence Brief Question

What are some novel packaging technologies currently in development for extending the shelf life of food and beverages throughout the industry?

We are primarily interested in developments ranging from mid- to near-term of development, generally categorized by having some substantial proof-of-concept testing completed currently. Solutions of interest would also be intended for direct food contact and be focused on packaging rather than changes/modifications to the food itself.

Executive Summary

PreScouter Approach:

The PreScouter team has selected several technological developments for inclusion in this report, and they are discussed/detailed on the pages that follow. Overall, the PreScouter team has highlighted uniquities among the solutions for easiest comparison. These include whether or not they are approved for food use and current development level. Additionally, page 5 of this report contains a brief discussion of the technologies included.

Discussion:

Every technology being developed to extend shelf life of a food or beverage has its own benefits and drawbacks. For example, any new material to be used in direct contact with food would require FDA (and/or government agencies, other country counterparts, etc) approval and would likely be under customer/consumer scrutiny in eventual use. A significant advantage is given to technologies in the report that already have approval for use in food. However, novel techniques earlier in development may be true disruptors on the horizon, despite an increased investment in development time and cost.

Executive Summary

One major trend seen throughout the research is a move toward more food- and plant-based additives and packaging, a “natural” approach as it comes across to consumers.

- ➔ NanoPack, university researchers, and Apeel are all using plant/food based components for superior coating materials.
- ➔ Other companies/groups are utilizing novel additives to slow food degradation (Stepac, p. 20 and Seawell, p. 28).
- ➔ In contrast to the former two ideas, some packages are utilizing older technology with a new spin. For example, Advanta (p. 16) is utilizing modified atmosphere packaging (MAP) within a new container so that chicken can be cooked directly in the package and the introduction of contaminants is avoided entirely.

Technologies Included in Report

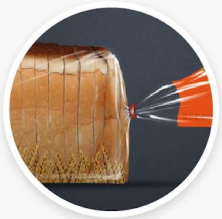
TECHNOLOGY

HALLOYSITE NANOTUBES

APPLICABILITY

PACKAGED GOODS (BREAD / FRUIT)

nanopack



TECHNOLOGY

NANOSILICA POWDER

APPLICABILITY

POTATOES

TECHNOLOGY

POULTRY TRAY

APPLICABILITY

POULTRY

ADVANTA

TECHNOLOGY

RESEALABLE LIDDING FILM

APPLICABILITY

FRUITS

StePac

TECHNOLOGY

MANGO PEEL

APPLICABILITY

FRUITS / POULTRY

BARC

TECHNOLOGY

SEAWELL- ABSORBENT

APPLICABILITY

SEAFOOD

MAXWELL CHASE
A CSP TECHNOLOGIES Company

TECHNOLOGY

GRAPHENE OXIDE

APPLICABILITY

BANANAS

INST
Institute of Nano Science and Technology

TECHNOLOGY

APEEL'S EDIBLE COATING

APPLICABILITY

AVOCADOES

APEEL SCIENCES™

TECHNOLOGY

ANTIOXIDANT NANOSELENIUM PACKAGING

APPLICABILITY

PACKAGED GOODS (NUTS / CHIPS / MEATS)

Universidad Zaragoza

The Major Features of Each Technology

Technology	Company / Organization	Phase	Food Use Approval	Type	Year	Page
Halloysite Nanotubes	nanopack	Research	✓	Antimicrobial packaging	2017	8
Nanosilica Powder		Research		Potato sprouting inhibitor	2018	12
Poultry Tray	ADVANTA	Product	✓	New foil packaging solution	2018	16
Resealable Lidding Film	StePac	Product	✓	Humidity-control packaging	2018	20
Mango Peel	BARC	Research		Antimicrobial packaging	2017	24
Seawell Absorbent	MAXWELL CHASE A CSP TECHNOLOGIES Company	Prototype	✓	Moisture absorbent packaging	2018	28
Graphene Oxide		Prototype		Preservative packaging	2018	32
Apeel's Edible Coating	APEEL SCIENCES	Product	✓	Invisible coating	2016	36
Nanoselenium Packaging	Universidad Zaragoza	Prototype	✓	Multilayer packaging	2018	40

Novel Packaging Solutions

Essential Oils in Biocompatible Nanopackaging

Background

Essential oils are oils derived from plants, such as oregano or thyme. Some essential oils have antimicrobial properties and can therefore be used to eliminate microbes from food products. Releasing the active ingredient in essential oils (carvacrol from oregano, for example) into packaged food products could help extend the shelf life of these products. NanoPack, an EU-funded three-year project consisting of various research institutions, is aiming to do that through developing an antimicrobial packaging made of nanomaterials that can be infused with these essential oils. The project began on Jan. 1, 2017 and is expected to be completed in 2020.

At a glance

Type: Antimicrobial packaging

Current Application: Bread

Key Feature: Halloysite nanotubes infused with antimicrobial essential oils

Applicability: Any type of packaged food

Year: 2017

Main Limitation: Possibly cost

Essential Oils in Biocompatible Nanopackaging

Technology

NanoPack uses halloysite nanotubes (HNTs), which are hollow clay mineral fibers composed of aluminum and silicon atoms. HNT absorbs ethylene produced by fresh food products, which acts as an aging hormone that ripens food items. The essential oils infused into the HNT packaging act as antimicrobial agents to eliminate microbes.

Essential oils are categorized as GRAS (Generally Recognized as Safe) by the US Food and Drug Administration, and the European Council who funded the NanoPack project stated that HNTs cannot migrate from food packaging into food items themselves, which deems them safe for use as food packaging.

Figure: NanoPack active packaging extends bread shelf life by 3 weeks. A first round of antimicrobial efficacy tests proved NanoPack film's ability to inhibit mold growth on food-additive free bread. The bread that was inoculated with mold spores and packed with NanoPack innovative film insert had no mold growing in the area exposed to the film for up to 27 days post packaging.

Essential Oils in Biocompatible Nanopackaging

Benefits

- HNTs and essential oils occur abundantly in nature, which means they are easy to obtain and are biocompatible.
- HNTs have high mechanical strength.
- Incorporating essential oils into the packaging would lend it antimicrobial properties.
- Adding essential oils contributes thermal stability which would allow HNT to be formed into various types of food packaging using existing techniques.

Drawbacks

- Essential oils have high volatility, so their release rate into foods may not be consistent at longer time periods.
- Duration of protection afforded has not been systematically studied on many food items (studies have been conducted on microbes extracted from food and on a few food items such as bread). So, more research is needed for widespread adoption.

Essential Oils in Biocompatible Nanopackaging

Conclusion

NanoPack's antimicrobial packaging solution can potentially replace conventional packaging films. The biggest bottleneck may be cost and development time. As the project is still in the research stage, a cost-effective solution could be developed.

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Nanosilica to Prevent Potato Sprouting

Background

While potatoes are a major food source in many regions, they can sprout during storage which decreases their commercial value. On top of that, high quantities of α-solanine are produced which is toxic when consumed by humans. Many methods have been developed to try and slow down the rate of potato sprouting, from cold storage to irradiation and chemical methods such as desiccation or application of organic chemicals to the potato surface. Researchers at the Chinese Academy of Sciences are currently developing a new method that uses hydrophobic nanosilica powder to prevent sprouting. Hydrophobic nanosilica powder is obtained through modifying nanosilica with amino silicon oil (ASO).

At a glance

Type: Potato sprouting inhibitor

Current Application: Potatoes

Key Feature: Surface treatment, non-penetrative

Applicability: n/a

Year: 2018

Main Limitation: Nanosilica waste runoff into sewage systems

Nanosilica to Prevent Potato Sprouting

Technology

To treat the potatoes, they are immersed in a solution of hydrophobic nanosilica powder dissolved in ethanol. It was determined that higher concentrations of hydrophobic nanosilica powder in the solution are better able to inhibiting sprouting.

To show that the nanosilica did not penetrate the potato skin, researchers looked at its concentration present on the outer surface of the potato skin before and after hand-washing with water as well as the amount present on the inner surfaces of the potato skin and showed that none of the nanosilica was able to penetrate the skin.

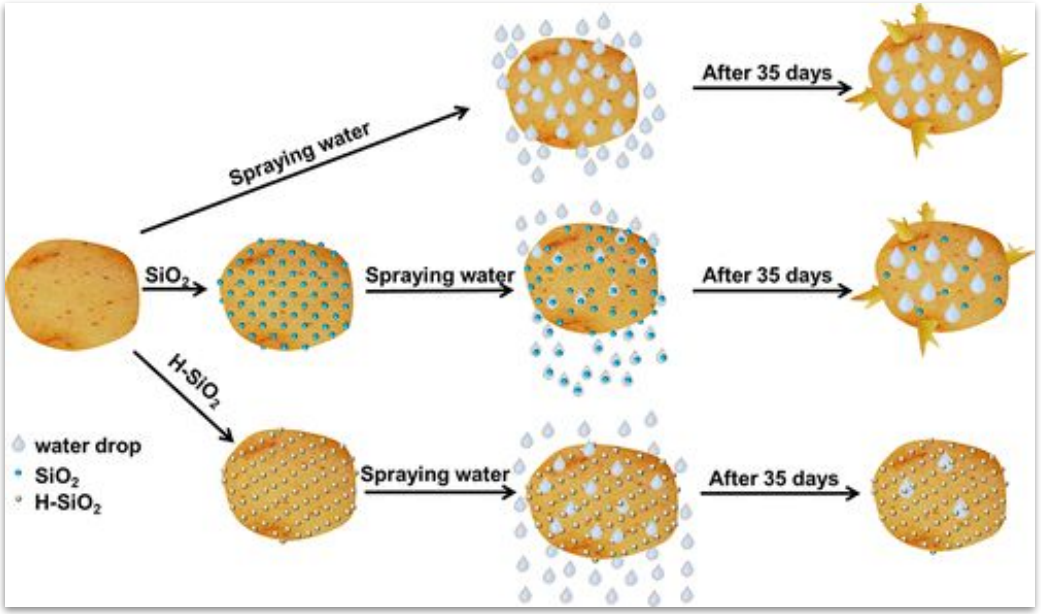

Figure: Hydrophobic nanosilica was fabricated to efficiently inhibit potato sprouting, which has a tremendous application potential for durable storage of potatoes.

Nanosilica to Prevent Potato Sprouting

Benefits

- Nanosilica does not penetrate into potato skin, making treated potatoes safe for consumption after hand-washing with water.
- Treated potatoes are still able to germinate when used as seeds in soil.
- Nutritional values of treated potatoes were not significantly influenced by treatment.
- Treatment cost was calculated to about US $5/ton of potatoes, making it a cheap treatment option.

Drawbacks

- Consumers may be hesitant to consume a product that has been immersed in nanosilica.
- Application of this method to other food products has not been investigated.
- Nanosilica waste after potatoes have been hand-washed may cause problems in the sewage system.

Nanosilica to Prevent Potato Sprouting

Conclusion

In UK households, 5.8 million potatoes are thrown away daily, at an annual cost of about 295 million USD. This research proves to be a cost-effective way to extend the shelf life of potatoes and significantly reduce food waste.

References

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2. https://www.theguardian.com/environment/2017/nov/08/nearly-half-of-all-fresh-potatoes-thrown-away-daily-by-uk-households

A Combination of Skin Pack Aluminum Tray and Film

ADVANTA

Background

Advanta, a global packaging supplier company has introduced a unique combination of chicken-shaped aluminum poultry tray and film to extend the shelf-life of poultry products. The skin pack is touted by the company as an excellent alternative to the standard modified atmosphere packaging (MAP).

At a glance

Type: New foil packaging solution

Current Application: Chicken

Key Feature: Alternative to MAP, plastic trays, Easy to use, thermally stable, eliminates the need of using preservatives in poultry

Applicability: Poultry products

Year: 2018

Main Limitation: Does not insure against spoilage, Packaging equipment needs proper cleaning and sanitization

A Combination of Skin Pack Aluminum Tray and Film

ADVANTA

Technology

The packaging combines the convenience of a chicken-shaped aluminum foil tray and shelf life extension to reduce food waste. The poultry is vacuum packaged in the foil tray, which gets rid of the oxygen. Removal of oxygen also gets rid of spoilage-causing microbes, as they require oxygen to grow. The low oxygen and high carbon dioxide environment significantly reduce the growth of microorganisms, allowing an increased shelf-life. The packaging can enhance the shelf-life of refrigerated poultry, sometimes by up to 300%.

Many customers do not want to touch an uncooked chicken. Advanta's packaging gets rid of this problem. The secure packaging lets customers to easily peel back the plastic film surrounding the poultry which reveals the whole chicken in a foil tray, ready to cook. Therefore, the chicken can be put straight in the oven without any complication. The new skin pack aluminum tray can withstand temperatures from -40°C to 400°C.

A Combination of Skin Pack Aluminum Tray and Film

ADVANTA

Benefits

- The packaging eliminates the need of using preservatives.
- It is robust, shatterproof while frozen and rigid in an oven.
- The tray is 100% recyclable and eco-friendly compared to plastic tray alternatives.

Drawbacks

- Vacuum products do not insure against spoilage.
- Vacuum packaging equipment needs to be cleaned and sanitized regularly.

A Combination of Skin Pack Aluminum Tray and Film

ADVANTA

Conclusion

With the consumption of poultry products on the rise, this packaging is unique and tailored for this purpose. Packaging will always determine a customer's interest in the product regardless of the quality or taste. Also, a tray that allows poultry to be cooked directly in the packaging makes it even more attractive. The product has generated a lot of interest among retailers and manufacturers as it offers a longer shelf-life with reduced supply-chain waste.

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Resealable Lidding FIlm

StePac

Background

In recent years, the demand for high-quality produce has driven the food industry to develop innovative and low-cost packaging solutions. StePac Ltd. has partnered with Tadbik, Ltd., Israel, to produce the next generation of the modified atmosphere resealable lidding film. The technology has been engineered to produce a combined effect of modified atmosphere (high CO_2 & low O_2), modified humidity (90-95%), and condensation control (release of excess moisture), and it has been used to ensure prolonged storage and shelf-life of fresh cherries.

At a glance

Type: Modified atmosphere/humidity packaging

Key Feature: Condensation and film permeability control, quality preservation, low cost packaging

Year: 2018

Current Application: Cherries and blueberries

Applicability: High quality fruits and vegetables

Main Limitation: Not tested with other fruits or high-value produce yet

Resealable Lidding FIlm

StePac

Technology

In collaboration with StePac, Tadbik generated a “Freshlid” laminated film, sealed to trays containing fresh produce and whose upper layer can be repeatedly peeled back for reuse. The packaging design helps in the shelf-life extension by slowing the process of respiration and aging, while keeping the humidity under check. The companies have worked together to design superior condensation control properties and film permeability to ensure optimal modified atmosphere conditions (MAP) for high-value fresh produce.

This Innovative fresh-produce packaging has been approved for extending the shelf-life of cherries and will be marketed under the Xgo, a leading retail brand of StePac.

In a successful pilot study, **Frutera San Fernando S.A., (FRUSERA)**, a market leader in the Chilean cherry export market, exported various refrigerated Cherry containers sealed with Xgo resealable lidding film in China. The success of this project has encouraged FRUSAN to export sealed cherries to Chile. Cherry pickers and shippers have also expressed tremendous enthusiasm. Moreover, the blueberry industry is also interested in using this technology.

Resealable Lidding FIlm

StePac

Benefits

- Xgo resealable lidding film preserves the freshness and flavor of cherries to more than 35 days.
- Consumers can savor cherries during extended home refrigerator life as the film ensures quality preservation.
- The seal maintains its attractive design through several uses.

Drawbacks

- Shelf-life extension of other food items has not been tested with resealable lids.

Resealable Lidding FIlm

StePac

Conclusion

These companies intend to work together to ensure high-value produce and ensure a fully regulated quality supply chain. Currently, the company is working to expand this technology in the Asian market. StePac has also entered into a collaboration with distributors in Peru and Chile to deliver the packaging solution to its customers.

References

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Mango Extract for Packaging Film

Background

Addition of antimicrobial agents into polymers used to make packaging films for food is a common solution to extend shelf-life. Mango peels show both antioxidant and antibacterial activity because they contain phenolics such as mangniferin, quercetin, ellagic acid, kaempferol, and their related conjugates. Researchers from the Bhabha Atomic Research Center (BARC) have shown that these compounds can be extracted and incorporated into existing bio-based packaging, such as those made out of a polyvinyl alcohol-cyclodextrin-gelatin composite film.

At a glance

Type: Antimicrobial packaging

Current Application: Poultry, fresh fruit

Key Feature: Antibacterial, ethylene inhibition

Applicability: Other proteins, produce

Year: 2017

Main Limitation: Cost

Mango Extract for Packaging Film

Technology

The phenolics in mango peels can be extracted by sonication with aqueous ethanol before the extract is then added onto composite films. With the known antibacterial properties of the phenolics, they consistently reduce bacterial activity in food items. It was demonstrated that the addition of mango peel extract to packaging film extends the lifespan of minced chicken kept in a fridge by 10 days. The films have also been shown to slow down the rate of ethylene production which slows down the rate of ripening (and rotting) of fresh fruit products.

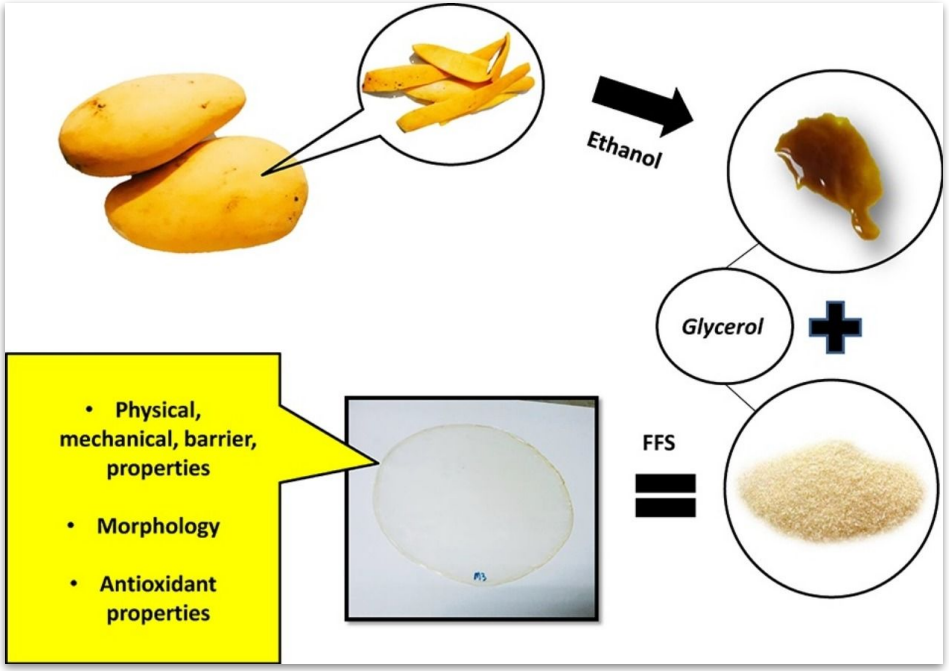

Figure: Graphical abstract from the article: Utilization of mango peel extracts on the biodegradable films for active packaging

Mango Extract for Packaging Film

Benefits

- The film has improved UV-blocking properties and higher tensile strength.
- The film does not affect gas balance of fruits when used to coat fresh fruit products.
- The extract is derived from food products, so it is safe for food contact.
- The film has higher hydrophobicity, which prevents water damage to food products.

Drawbacks

- Its use for products other than fresh fruits and chicken needs to be investigated
- Duration of protection afforded for different food items has not been systematically studied on actual food items.
- Cost of production for biodegradable films are still high.

Mango Extract for Packaging Film

Conclusion

Research indicates that mango peel-based packaging films carry significant antioxidant and antimicrobial properties. This biobased innovation, with further research, has the potential to be used as an active packaging solution and reduce plastic packaging waste.

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SeaWell: Preserving Frozen and Fresh Seafood

MAXWELL CHASE
A CSP TECHNOLOGIES™ Company

Background

Moisture absorbers are commonly used to control excess water accumulation inside the packages of food with high moisture content such as meat, fish, poultry and fresh produce. In recent years, a lot of companies are coming up with innovations in absorbent technology by combining various polymers to control moisture, which inhibits microorganisms, mold and increases the freshness of food. SeaWell Packaging Solutions has introduced a packaging line to extend the shelf life of frozen and fresh seafood.

At a glance

Type: Moisture absorbent packaging

Current Application: Frozen and fresh seafood

Key Feature: Automation-friendly, Integrated absorbent technology

Applicability: Protein-rich products, Industrial kitchens (high-speed production environment)

Year: 2018

Main Limitation: Patent-pending

SeaWell: Preserving Frozen and Fresh Seafood

MAXWELL CHASE
A CSP TECHNOLOGIES™ Company

Technology

SeaWell Seafood packaging trays designed by the Maxwell Chase company are designed for significantly enhancing the shelf-life of both fresh and frozen seafood. The trays are made of recyclable polypropylene and feature an integrated absorbent technology incorporated into wells at the bottom to absorb excess fluids. With the superabsorbent polymer, the tray acts as an active water scavenging system to prevent the exposure of food to fluids. Consequently, these trays lower any potential damage to seafood products.

The company claims that the technology can extend the shelf life of fresh seafood by 50% or even more. Along with extending the shelf life of frozen and fresh seafood, the trays can also work for other protein products such as meat.

SeaWell: Preserving Frozen and Fresh Seafood

MAXWELL CHASE
A CSP TECHNOLOGIES™ Company

Benefits

- The trays also help in keeping the food fresh, safe, free of odors, and damage.
- Automation-friendly, these trays are suitable to be used in places with a high-speed production environment.
- The seafood can be packed frozen and thawed in the same package without affecting the product integrity. Moreover, the fluids absorbed in the tray's wells and are invisible to the consumers.

Drawbacks

- The technology is currently in the patent-pending stage.

SeaWell: Preserving Frozen and Fresh Seafood

MAXWELL CHASE
A CSP TECHNOLOGIES™ Company

Conclusion

The company claims that SeaWell seafood trays have the potential to revolutionize the seafood industry. Other protein products such as meat products are being tested to be packaged using this technology. The company is working with different customers at different stages of commercialization.

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Graphene Oxide for On-Demand Preservatives

Background

Many preservatives are added to the surface of fruits to slow down the rate of ripening and growth of microbes. Some of these preservatives, such as benzoic acid and sorbic acid, have been found to be toxic for humans. This has encouraged a push towards preservatives based from natural extracts ilke pomegranate peels, but even parabens which can be found in nature (although produced synthetically) have negative side effects both physiologically and environmentally. Furthermore, different fruits require different amounts of preservatives at different stages of ripening. Researchers at the Institute of Nano Science and Technology are currently creating a wrapper that takes in stimuli from each fruit to determine the dosage of preservatives it should release.

At a glance

Type: Preservative packaging

Current Application: Bananas

Key Feature: Stimulated by fruit to release preservative from wrapper

Applicability: Fruits

Year: 2018

Main Limitation: Not tested on other types of food

Graphene Oxide for On-Demand Preservatives

Technology

The wrapper itself is made out of graphene oxide (GO), which has a high surface area and is inert to prevent the wrapper from reacting with the preservative. The preservative used is salicylaldehyde (SA), and bananas were used as a sample fruit. The GO-SA composite is dispersed on filter paper to prevent direct contact with the fruit.

As bananas ripen, they release acids which triggers the release of SA from the wrapper and slows down the ripening process. Using the graphene oxide base provides antimicrobial protection on the fruit against two common microbes in plants, *E. coli* and *P. syringae*.

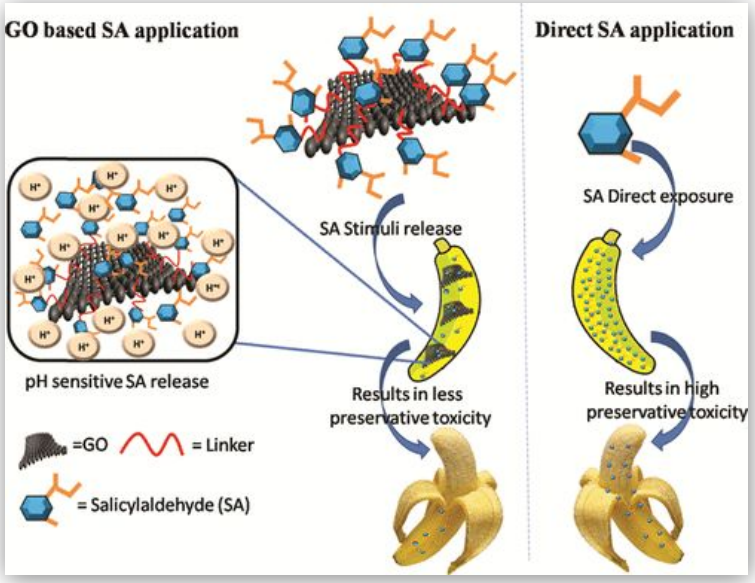

Figure: Graphical abstract from: Ecofriendly Fruit Switches: Graphene Oxide-Based Wrapper for Programmed Fruit Preservative Delivery To Extend Shelf Life

Graphene Oxide for On-Demand Preservatives

Benefits

- The preservative delivery is triggered by the release of acids by ripening fruits, so this technique should be applicable to other fruit products
- Minimal toxicity as neither the GO nor the SA can pass through the filter paper used in the wrapper into foods
- Wrapper is flexible and has tensile strength comparable to normal cellulose-based paper

Drawbacks

- This technique has not been investigated for other types of food products (grains, dairy, meats)
- Composite may be lost to the environment, which could pose environmental risks
- Bacteria can interact with GO, changing its surface characteristics
- Effects of wrapper on the rate of ripening at the very late stages of the ripening process is minimal

Graphene Oxide for On-Demand Preservatives

Conclusion

This technology meets three important criteria: antimicrobial, controls ripening and is not in direct contact with fruit. However, this GO wrapper may have limitations in the later stages of ripening, when the acid content reduces and the late polymerization forms a lignin. The researchers plan to address this challenge in their next step of research.

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Apeel's Edible Coating

Background

Apeel Sciences, a food-tech startup company, has developed an invisible, edible coating to be sprayed on produce for shelf-life extension. The company claims that the coating slows decay which allows avocados to last twice as long as conventional avocados. Apeel introduced its avocados at Costco and Harps food store locations in American Midwest. Harps has reported promising lifts in the sales of Apeel's avocados. The company has raised $40 million from several high profile investors, including the Bill and Melinda Gates Foundation and an additional $70 million in a funding round led by Viking Global Investors, Andreessen Horowitz, Upfront Ventures, and S2G Ventures.

At a glance

Type: Invisible coating

Key Feature: Edible, plant-based

Year: 2016

Current Application: Avocados

Applicability: Fruits, vegetables

Main Limitation: Coating cannot be washed off

Apeel's Edible Coating

APEEL SCIENCES™

Technology

Apeel uses plant-based materials such as the leftover peels of fruits and vegetables to develop an invisible natural coating. The coating is tasteless and is safe as per the criteria of the FDA. It starts off as a powder which is mixed with water to create a solution. This solution is either used as a dip or a spray on fruits and vegetables. The coating controls the rate at which water escapes from the surface of fruits and vegetables and the rate at which oxygen enters to preserve the quality.

The coating acts as a protective seal slowing down the decay and thus the oxidation process. After the coating dries, it locks in moisture and acts a barrier against natural gases including ethylene and oxygen to ripen the avocados. The cost of avocados treated with the coating is the same as the conventional ones with an extended shelf-life.

Figure: A comparison of untreated avocados (left) and avocados treated with Apeel's edible coating (right) after 26 days.

Apeel's Edible Coating

Benefits

- Natural, clean-label ingredients
- Coating is safe for human consumption
- Tested on more than 20 different fruits and vegetables
- Tasteless, odorless and colorless
- Prolongs shelf-life significantly, in some cases doubling it

Drawbacks

- Produce must be clean before applying Apeel coating
- Coating cannot be washed off

Apeel's Edible Coating

Conclusion

Refrigeration is useful to increase the quality of produce during storage and transportation. However, it is not widely available across the supply chain in some developing countries. Apeel's edible coating could help preserve fruits and vegetables in such conditions. Although the company started with avocados, formulation of the coating could be modified for other fruits and vegetables. The company plans to introduce treated Asparagus in stores next.

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Antioxidant Packaging With Nanoselenium

Universidad Zaragoza
1542

Background

Researchers at the University of Zaragoza are exploiting the scientifically established antioxidant properties of selenium nanoparticles to develop a flexible, multilayer active packaging solution. The packaging was tested both in the laboratory and on an industrial scale. This is the first study where an industrial active multilayer containing selenium nanoparticles as an antioxidant agent is investigated.

At a glance

Type: Multilayer packaging

Key Feature: Antioxidant, flexible

Year: 2018

Current Application: Hazelnuts, walnuts, potato chips, cooked ham, chicken, ready-to-eat vegetables

Applicability: All types of packaged goods

Main Limitation: Does not improve barrier properties, hexanol values unreliable in the tests

Antioxidant Packaging With Nanoselenium

Universidad Zaragoza
1542

Technology

Antioxidant packaging acts by absorbing compounds such as oxygen or free radicals, that lead to food deterioration. Based on the antioxidant properties of selenium nanoparticles, researchers built and optimized a flexible multilayer material containing nanoselenium (nanoSe). The nanoSe was placed in the middle of the multilayer to not affect the performance of the plastic film.

The nanoSe packaging was tested with food susceptible to rancidity in the lab as well as on an industrial scale.

- In the lab, researchers studied the fatty acid content, malondialdehyde (MDA) levels and sensory profile of hazelnuts and walnuts placed in the nanoSe packaging. For all tests, nuts placed in the nanoSe packaging, after 42 days, showed higher fatty acid content, lower levels of MDA and a better sensory profile when compared to the control group. Potato chips were also studied and showed a 22% decrease in MDA.
- On an industrial scale, cooked ham, chicken, and ready-to-eat vegetable mixture seasoned with butter were tested. After 21 days, the most significant decrease in MDA was seen with ham (50% decrease).

Antioxidant Packaging With Nanoselenium

Universidad Zaragoza
1542

Benefits

- Evaluated and received a positive opinion from EFSA (European Food Safety Authority)
- No migration of selenium nanoparticles to food
- Performance as a strong free radical scavenger was demonstrated successfully with the lab and industrial tests
- Multilayer with Se nanoparticles performs well in lab as well as on an industrial scale

Drawbacks

- Does not enhance the barrier properties of the multilayer for organic vapors, such as aldehydes
- Hexanal, the main product of linoleic oxidation by nuts was not reliable.

Antioxidant Packaging With Nanoselenium

Universidad Zaragoza
1542

Conclusion

The active packaging based on selenium nanoparticles demonstrates promising results with extending the shelf-life of nuts, potato chips, cooked ham, chicken and ready-to-eat-vegetable mixture. By acting as a scavenger of free radicals, the presence of nanoSe in the packaging delays the oxidation of food materials. With the new antioxidant material, considerable improvements in the food products have been confirmed. The incorporation of selenium nanoparticles in packaging materials seems to be a promising new method for improving the shelf-life of packaged foods.

References

1. https://www.mdpi.com/2079-4991/8/10/837/pdf

Next Steps

Topic	Question	Report
Extending Shelf Life of Foods and Beverages	What are novel technologies currently in development for extending shelf life?	*Extending Shelf Life- Novel Packaging*
		Extending Shelf Life- Next Generation Additives
		Extending Shelf Life- Food Treatment Methods
Food and Beverage Packaging Market	Who are main players in the industry and what are major technological trends in the coming years?	Overview of Startups in Packaging
		Discussion of Market Trends
		IP Landscape of Market Players
		Analysis and Discussion of Market
Trends in Allied Industries	What can we learn from packaging technologies in other industries?	Identification of Industries and General Packaging Ideas
		Deep Dive into Highlighted Packaging Technologies

About the Authors

Paula Hock, PhD

PreScouter

Professional Summary:

Paula is one of PreScouter's Project Architects and is one of the Primaries in the Transportation Segment. She has worked on a wide variety of projects in her tenure, including topics like coatings and materials research, process optimization in many industries, comparative intelligence, and more. Paula earned her B.S. from DePaul University in Chemistry before continuing on to her Ph.D. in Physical Chemistry at the University of Pittsburgh. There, her research focused on characterization of organic semiconducting thin films for use in electronic devices. That is also where she started with the PreScouter Global Scholars program in August of 2014. After working as a scholar for a few months, she became a Team Leader before eventually taking a full-time role with PreScouter.

About the Authors

Navneeta Kaul, PhD

University of Denver, USA

Professional Summary: Navneeta Kaul recently completed her PhD in Biology at the University of Denver in Colorado. After earning an engineering degree in Biotechnology, her passion for cutting-edge biological research motivated her to pursue her Master's at the University of Arizona in Tucson. At the University of Denver, she studied the biological mechanism behind Fragile X syndrome, an autism spectrum disorder affecting nearly 1.3 million adults in the United States.

Research Background: Navneeta graduated with a PhD in Biology from the University of Denver in August 2018. The focus of her research was to understand the mechanism of local protein synthesis at the synapse which is important for memory formation in vertebrates. She has experience in using biochemical and molecular biology techniques like cloning, PCR, real-time PCR, western blotting, immunoprecipitation, live cell and fixed cell imaging.

Scientific Interests: Scientific communication, Scientific consulting, Life sciences.

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Natasha Jane Chrisandina

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Professional Summary: Natasha recently completed her Master's of Science in Chemical Engineering at the Georgia Institute of Technology. While completing her degree, she worked on possible industrial extraction methods and applications for lignin. She has also written science articles for the PreScouter Journal, Massive Science Consortium, and Lateral Magazine.

Research Background: Natasha's research work focused on designing a process for more efficient solvent and water recovery during lignocellulosic biomass pretreatment for pulp mills and determining its economic and engineering feasibility. She also worked on investigating the mechanism of biomass depolymerization through mechanocatalysis.

Scientific Interests: Chemical process design, techno-economic analysis, lignocellulosic biomass, science communication

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