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The Effect of Soy Protein Concentrate/Whey Protein Edible Coatings on the Quality of Semi-dried Potato Slices

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Abstract

Edible coatings can be an effective and environmentally friendly method for preserving food quality during storage. This concept sets the research stage that explores how coatings made from soy protein concentrate and whey protein can enhance the chemical stability of potato slices, thus improving their preservation and overall quality during storage. The study lays the groundwork for investigating the effects of these coatings on various physicochemical properties of semi-dried potatoes, ultimately highlighting their potential benefits in food preservation. In this research, the impact of different concentrations (2.5, 4, and 5 w/w %) of soy protein concentrate and whey protein on some physicochemical properties of semi-dried potatoes (color, rehydration of dried slices, reducing sugars, starch, ascorbic acid, moisture, oil absorption, texture crispness, and sensory properties) during 60 days of storage were investigated. The results showed that semi-dried potatoes coated with soy protein concentrate and whey protein had the highest moisture content and the lowest oil absorption and crispiness compared to the control sample. The sensory properties of coated samples were different from those of uncoated samples. Panelists also accepted the taste of coated semi-dried potatoes. The applied edible coatings significantly affected the ascorbic acid and reducing sugar content. The lowest and highest amount of starch was observed in the control and coated samples, respectively. These characteristics show that coatings based on soy protein concentrate and whey protein considered to be an excellent choice to reduce oil absorption and increase shelf life of potato slices.

Keywords: Dried potato, Edible coating, Shelf life, Soy protein, Whey protein

Introduction

Research in the field of food packaging is mostly focused on environmentally friendly or biodegradable films made of polysaccharides, fats, proteins, or a mixture of these compounds. Protein coatings are well-connected to the hydrophilic surface and prevent oxygen and carbon dioxide, but are not resistant to water penetration (Moslehi *et al*., 2023). These films are prepared from edible proteins of plant and animal origins, like zein, wheat gluten, soy, peanut, albumin, gelatin, collagen, casein, and whey proteins (Ananey-Obiri *et al*., 2018). Edible coatings act as good moisture insulation and reduce these problems. When packing, the water leak in the package creates an unfavorable appearance for the consumer.

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Edible coatings preserve the product's nutrients and eliminate using moisture-absorbing pads in the packages. The speed of rancidity and browning reactions in foods is reduced when surrounded by coatings with low permeability to oxygen. In addition, the loss of volatile aromatic substances and the absorption of external odors from the environment are limited by edible coatings. Some researchers have used food coatings containing antioxidants or antimicrobial substances as active packaging for the direct treatment of food, and the results reported by these researchers indicated that this action delayed pungency, unfavorable color changes, and reduced microbial load (Moslehi *et al*., 2015). Sarfraz *et al*. (2024) discussed the benefits of edible coatings, particularly their contribution to improving food safety and quality. They discussed chitosan-based films, which provide antimicrobial and antioxidant properties, thermal stability, and improved barrier capacity, making them suitable for sustainable food packaging (Sarfraz *et al*., 2024). Kandasamy *et al*. (2021) discussed the development and potential of whey protein-based edible films and coatings as sustainable food packaging solutions (Kandasamy *et al*., 2021). These films, made from whey protein isolate or concentrate, offer excellent mechanical and barrier properties, flexibility, and transparency while carrying active ingredients like antimicrobials and antioxidants. Di Pierro *et al*. (2018) highlighted the diverse proteins found in whey, which can be utilized in active food packaging (Di Pierro *et al*., 2018). These proteins offer the potential to develop bioactive packaging materials with health benefits, extend shelf life, and enhance food safety. In addition, the environmental problems caused by food packaging waste will be reduced. Water constitutes a high percentage of the fresh weight of fruits and vegetables. Therefore, compared to other plant products such as seeds, they show high metabolic activity. This metabolic activity continues after harvest, so it causes many fruits to be perishable goods. One of the ways to improve the durability of fruits is to reduce their moisture so that microorganisms cannot grow. Drying is one of the significant processes that can increase the shelf life of food after harvesting (Martínez-Pineda *et al*., 2021).

The drying process is widely used to preserve fruits and vegetables, the primary purpose of which is to bring water to a level that minimizes microbial spoilage, chemical reactions (Such as color and taste), and enhances the mechanical properties (such as fracture resistance) (Giancaterino *et al*., 2024). In addition to play a protective effect on the product, drying significantly reduces the weight and volume and thus reduces the cost of transportation and storage of the product (Wang *et al*., 2023). One of the most fundamental goals of drying agricultural products is to remove water to a certain level to slow down microbial spoilage and chemical interactions (Rashid *et al*., 2022). In this research, we aimed to enhance the chemical stability of semi-dried potato sticks during storage by applying appropriate edible coatings. Since the semi-dried potato slices available in frozen conditions are kept in the freezer, it is possible to keep them for a longer time in the refrigerator by semi-drying them. By using the coating of soy protein and whey protein, which improves the quality characteristics and increases the shelf life of potato slices, it is possible to provide a product that can be made in easier conditions and offered with better quality.

Materials and Methods

Materials

Whey protein (85%) was bought from Arla Denmark, and soy protein was collected from the Somiah Company in Behshahr. N-hexane (with a purity of 95%), 2,6-dichlorophenol, indophenol, calcium chloride, sodium hydroxide, Fehling A and B, and glycerol were obtained from Merck, Germany, and frying oil (a mixture of sunflower, soybean, and cottonseed) was purchased from Behshahr Industrial Company.

Preparation of Potato Sticks

The Agria potatoes were obtained from farmers in Golestan province. The potatoes were peeled with a sharp knife and sliced with a homemade slicer into sticks with dimensions of 6×1×1 cm. They were then blanched for 4 minutes in boiling water and immediately washed with cold water (Shakouri *et al*., 2018).

Preparation of Coatings from Whey Protein and Soy Protein Concentrate

The concentrations of whey protein and soy protein concentrates were chosen based on findings from a literature review and initial laboratory tests. Whey protein concentrate with concentrations of 2.5%, 4%, and 5% (w/w dry matter) was prepared in distilled water and stirred on an Erlenmeyer shaker (Mrhei-Standard/Heidolph, Japan) at 180 rpm for 1 hour. The solution was then heated in a water bath (Shimaz co. SHVB15) at 90°C for 1 hour and immediately placed in ice water to prevent protein denaturation. As a plasticizer, 2.5% (w/w dry matter) of glycerol was added to the solution and stirred for 10 minutes in an Erlenmeyer shaker at 140 rpm. The solution was then filtered (Sheerzad *et al*., 2024). Soy protein concentrate was dissolved in distilled water at three concentrations of 2.5%, 4%, and 5% (w/w dry matter), then glycerol was added as a plasticizer (50% of the weight of soy protein concentrate). The pH of the solution was adjusted to 10 with 0.1N sodium hydroxide. The solution was stirred on a magnetic hot plate for 20 minutes (Erdem & Kaya, 2021). Potato sticks were immersed in protein coating solutions for 2 minutes, after which the coated and uncoated samples were placed in the oven (model D91126, Memert, Germany). For the heat to reach all sample surfaces uniformly, the samples were continuously turned upside down during drying. The drying process continued until the moisture content of the samples reached 30%. The control (Semi-dried sticks without coating treatment) and treatment (coated) samples were then packed in polyethylene bags and stored at 4°C. The qualitative properties of control and treatment samples were determined after 20, 40, and 60 days of storage (Karacabey *et al*., 2023).

Methods

The tests carried out in this research include: colorimetry, rehydration of dried slices, measuring the amounts of reducing sugars, starch, ascorbic acid, moisture, oil absorption, texture crispness, and sensory evaluation.

Colorimetry

Image processing was used for colorimetric measurement of coated and uncoated samples. An HP Scanjet scanner was used to prepare images of samples with a resolution of 300 dpi. The images were converted from RGB to LAB color space using the software's color-space converter plug-in. Then the b*, a*, and L* parameters of the potato images were obtained by Image J software version 1.5 (Ziaolhagh *et al*., 2017)

Rehydration

To check the samples' water absorption ability, they were immersed in distilled water (approximately 100 ml of water per 5 grams of the sample) at ambient temperature. The rehydration was continued until the potato slices attained constant weight. The maximum ability of the samples to reabsorb water was calculated from Equation (1), where M_1 and M_2 are the sample weights before and after rehydration, respectively (Jafari *et al*., 2019).

$$\%rehydration = \frac{M_2 - M_1}{M_2} \times 100 \qquad (1)$$

Starch and Reducing Sugars

The polarimetry method was used to determine starch. The semi-dried potatoes were ground by a Nicer Dicer model chopper for 3 minutes at high speed. Ten milliliters of distilled water and 65 ml of calcium chloride were added to 2.5 g of powdered potato in a 250 ml Erlenmeyer flask. The solution was heated for 25 minutes at 120ºC, cooled to room temperature, poured into a 100 ml flask, and washed with calcium chloride. Then 2 ml of sucrose was added to a balloon and was made up to 100 ml with calcium chloride. The content of the balloon was filtered and poured into the WXG-4 Disk polarimeter-chin cell, and the percentage of starch was calculated from Equation (2) (Parvaneh, 2022).

$$C = \frac{100\,A}{L[\![\alpha]\!]} \times \frac{100}{W} \qquad (2)$$

Where C is the starch percent, A is the optical rotation in degrees, L is the length of the polarimeter cell (dm), α is the specific rotation degree (195.2) and W, is the sample weight. Fehling method was used to determine reducing sugar (Parvaneh, 2022).

Ascorbic Acid

Ascorbic acid was measured according to the method described by the National Standard of Iran, No. 5609 (Iran Institute of Standards and Industrial Research, 1994). Five grams of powdered potato samples were dissolved in 5% (w/v) metaphosphoric acid and titrated against 2,6-dichloroindophenol solution. The ascorbic acid content was expressed as milligrams per 100 grams of dried potato.

Moisture

The moisture content was measured using the weight difference method following the approach of Ziaolhagh and Kanani, with some modifications (Ziaolhagh & Kanani, 2021). Approximately 5 grams of each sample were placed in designated containers and dried in an oven set at 105ºC for about 5 hours until a stable weight was reached. The moisture content was calculated by determining the weight difference, as outlined in Equation (3).

$$\%Moisture = \frac{M_1 - M_2}{M_1} \times 100 \quad (3)$$

M_1 and M_2 are the sample weights before and after drying, respectively.

Oil Absorption

Frying was done using a home fryer and a mixture of soybean and sunflower oil (Bahar brand) at 175°C. The semi-dried potato samples were fried in oil until a light color and crispy texture were obtained (2.5 minutes). Then, the samples were cooled to room temperature. Soxhlet extractor (Jerhardt, Germany) with n-hexane was used to determine oil content. The oil absorption ratio was reported as the percentage difference between the amount of oil in the sample before and after frying (Shakouri *et al*., 2018).

Crispness

The crispiness of potato slices was evaluated using Kramer's test with a texture tester (HOUNSFIELD H5KS). Five vertical blades were employed, and four potato sticks were tested in each trial. The blades moved at a speed of 96 mm per minute, with a penetration depth set to 13 mm. In each test, the amount of force required for cutting was recorded (Grau *et al*., 2024).

Sensory Evaluation

Ten trained panelists, aged 20 to 40 years, evaluated the sensory characteristics of the potatoes, including color, texture, taste, and overall acceptance, based on a five-point hedonic scale. The potato samples were fried before being given to the panelists for sensory evaluation. In addition, the panelists were asked to drink cold water after testing each sample.

Statistical Analysis

All measurements were done in three repetitions using “Repeated Measure” and “Univariate” tests. Muchly's Test of Sphericity was performed before the repeated-measure test. Analysis was performed using SPSS 0/17 (SPSS Inc., Chicago, IL).

Result and Discussion

Colorimetric

Fig. 1A-C show the lightness (L*), red-green (a*), and yellow-blue (b*) of semi-dried potatoes. The results showed that the brightness increased significantly as the concentration of both coatings increased ($p>0.05$). In all concentrations and for both types of coatings, the lowest level of lightness was on day 60 (Fig. 1A). The intensity of the green color of the samples increased with increasing concentration (decrease of a*). Moreover, the a* increased in the control sample. In addition, the a* increased during storage. The results of the statistical analysis also showed that the interaction effect of time and concentration was significant ($p>0.05$) (Fig. 1B). The yellow-blue index (b*) in the semi-dried potato samples coated with soy protein concentrate and whey protein increased over time. This index decreased significantly as the concentration of the coating proteins increased ($p<0.05$). In addition, the b* value of uncoated samples was more significant than that of coated samples (Fig. 1C).

Laksana *et al*. (2024) showed that fresh-cut apples covered by whey protein had the highest value in lightness/darkness (L*) and yellow/blue index (b*) ($p<0.05$) (Laksana *et al*., 2024). The authors attributed the obtained results to the oxygen barrier and the antioxidant property of whey protein, which was attributed to the anti-browning amino acid cysteine. The green-red index (a*) of the potatoes coated with soy protein concentrate and whey protein was estimated as -2.26 and -2.99, respectively, which were significant ($p<0.05$). This agreed with the findings of other authors who worked on potatoes, apples, and pears (Aayush *et al*., 2022).

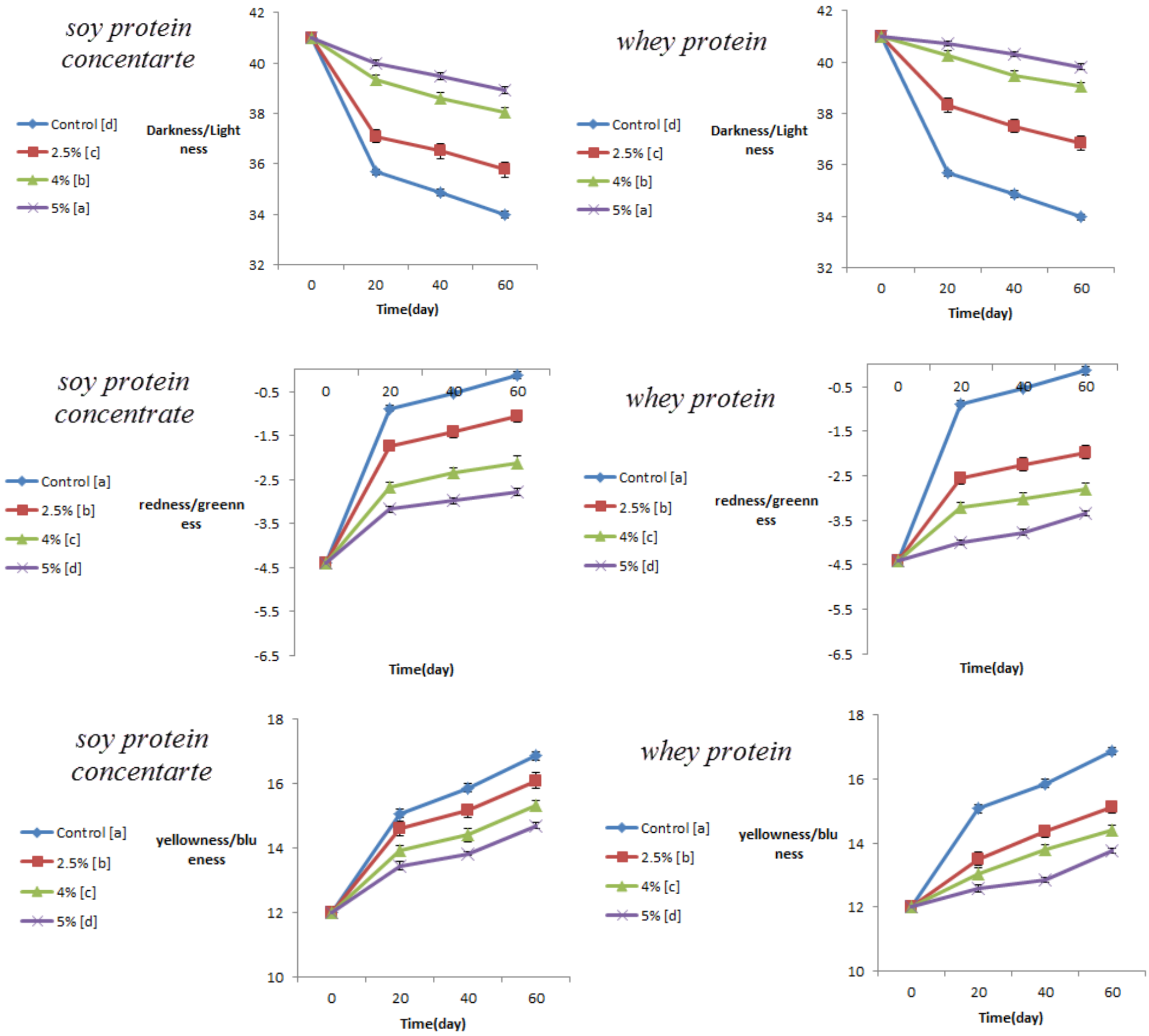

Fig. 1. The effect of different concentrations of soy and whey proteins on (A) the light-darkness index (L*), (B) the red/green index (a*), and (C) the yellow-blue index (b*) of semi-dried potatoes

Rehydration

Fig. 2 shows the effect of whey and soy protein coatings on the rehydration characteristics of semi-dried potatoes during 60 days of storage. Samples with 5% soy or whey proteins absorbed the most water. This observation could be related to the constant storage capacity of dry matter. With the increase in coating concentration, the amount of water absorption increased due to the change in water absorption capacity (WAC). Rehydration decreased significantly by storage time ($p<0.05$). Most potatoes and their products are made up of starch and sugars, and the starch changes over time, which leads to the so-called staleness or retrogradation. Retrogradation is a phenomenon that occurs as a result of the staling of starch materials, and generally, the connection of amylose chains to each other is responsible for its occurrence. As the retention time increases, the connection of long amylopectin branches to each other causes aggravation. These structural changes are responsible for phenomena such as the decrease in water absorption power of the samples and the decrease in their transparency (Rolandelli *et al*., 2024).

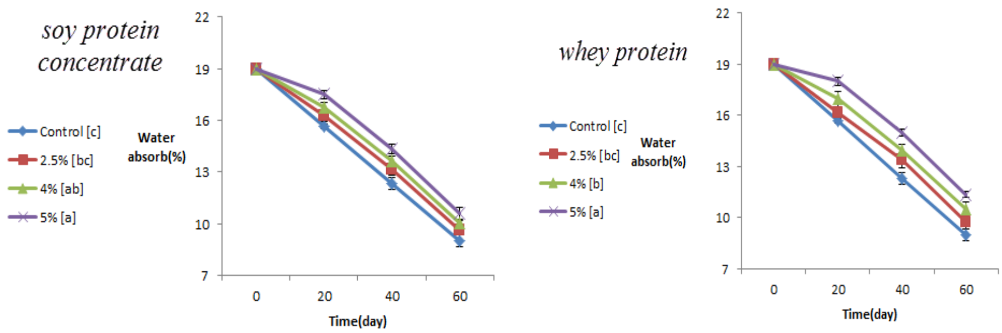

Fig. 2. The effect of soy protein concentrates and whey coating on the Water reabsorption of semi-dried potatoes

Starch and Reducing Sugar

Fig. 3 shows the amount of starch in semi-dried potatoes coated with soy protein concentrate and whey protein. Soy protein coating at a concentration of 2.5% showed no significant difference with the uncoated potato samples ($p< 0.05$). Semi-dried potatoes in both coatings had the lowest amount of starch on day 60 because the breakdown of starch with the help of amylases during drying by hot air causes a further increase in water binding capacity and a decrease in viscosity, and its digestibility increases. Therefore, starch is easily removed from dried products (Flores-Silva *et al*., 2023).

This research found that the starch content in potatoes coated with whey protein was significantly higher than in those coated with soy protein concentrate ($p < 0.05$). Potatoes coated with 2.5, 4, and 5% of whey protein and the control sample showed no significant difference ($p>0.05$).

Fig. 4 indicates that the reducing sugar in potatoes coated with both types of protein increased with time ($p<0.05$). However, the interaction effect of time and concentration was not statistically significant ($p>0.05$). The highest amount of reduced sugar was seen in the control sample, which can be due to the rapid conversion of starch to sugar due to the reduction of moisture and acidity through physiological changes during the storage period.

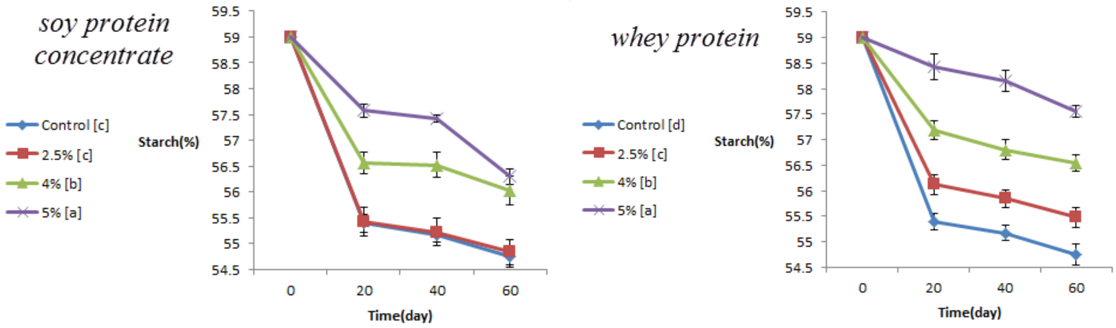

Fig. 3. The effect of soy protein concentrates and whey coating on starch in semi-dried potatoes

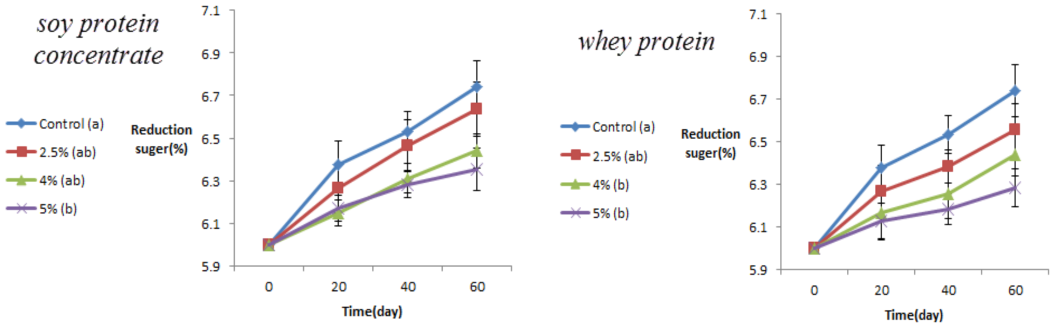

Fig. 4. The effect of soy protein concentrates and whey coating on reducing sugar in semi-dried potatoes

Ascorbic Acid

Fig. 5 shows the effect of different concentrations of soy protein concentrate and whey protein coatings on ascorbic acid. In both coatings, the ascorbic acid content of semi-dried potatoes significantly increased with the concentration increase ($p < 0.05$). The higher ascorbic acid content of the coated samples was due to the low oxygen permeability of the coating. The oxygen had less contact with the coated potatoes, which reduced enzyme activity and prevented the oxidation of ascorbic acid (Etxabide *et al.*, 2023). In addition, whey protein has antioxidant properties due to its amino acid cysteine, which reduces the loss of ascorbic acid due to oxidation (Chen *et al.*, 2023). During the storage time, the amount of ascorbic acid decreased ($p < 0.05$). As the storage time increased, the samples were exposed to light and air for a longer time, and as a result, the amount of ascorbic acid decreased due to its sensitivity to light and oxygen. The type of coating used showed no significant effect on the ascorbic acid content of the potato sticks during the storage period ($p>0.05$).

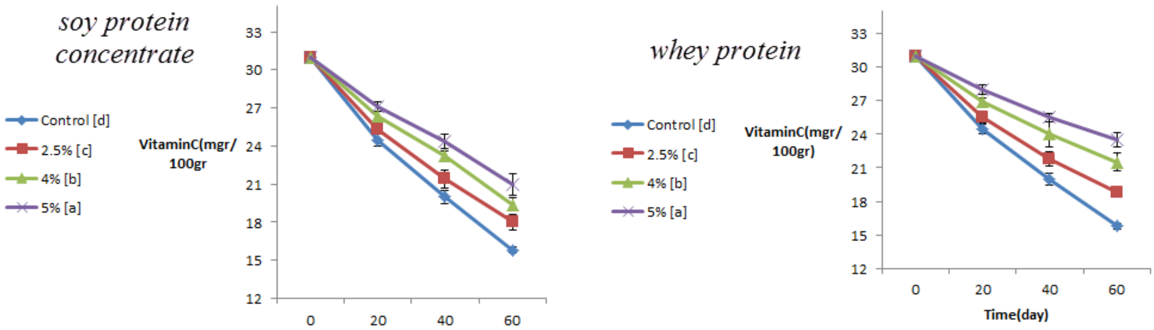

Fig. 5. The effect of soy protein concentrates and whey coating on the ascorbic acid of the semi-dried potato

Moisture

Fig. 6 shows the effect of soy concentrate and whey protein coatings on the moisture content of semi-dried potatoes during storage. Potatoes coated with 5% concentration of both types of coatings showed the highest amount of moisture. A significant decrease in water content was observed during storage time ($p<0.05$). The most important feature of food film or coating is its hindrance to moisture. Changes in the moisture level of food can occur inside or between the food and the air around it. The moisture transfer rate between the food and the surrounding atmosphere is reduced by completely covering the food with a film or coating (Sakooei-Vayghan *et al.*, 2021). These results may be attributed to the excellent barrier properties of whey proteins due to their disulfide bonds and hydrophobic effect. Also, whey protein contains calcium, which increases the hydrophobicity of the protein. The increase in hydrophobicity can be attributed to divalent calcium cations, which cause the creation of cross-links between hydroxyl groups in peptides, and as a result, the bonds with water decrease, which causes the creation of a moisture barrier structure of films (Dedebas, 2024). The amount of moisture in potatoes coated with soy protein concentrate was significantly higher than that coated with whey protein ($p < 0.05$). The soy film is a homogenized oil-in-water emulsion, and the emulsification property of proteins has a linear relationship with its hydrophobic surface, so it can be considered that soy protein is a barrier against moisture, which is due to its inherent hydrophobic properties.

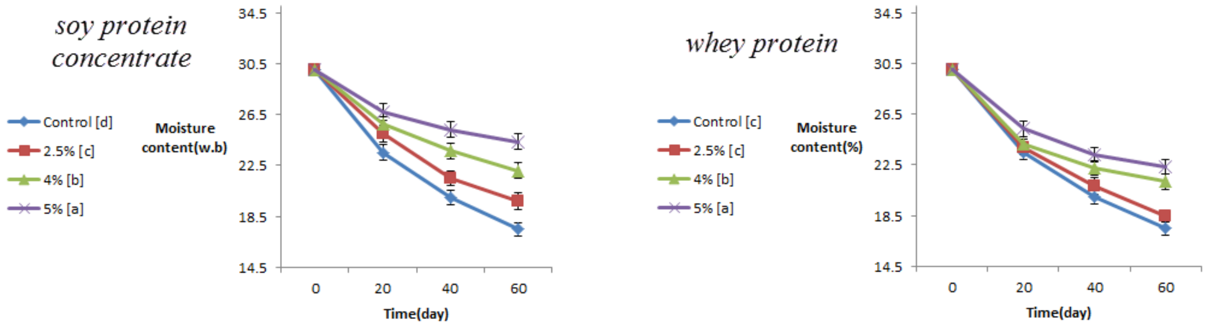

Fig. 6. The effect of soy protein concentrates and whey coating on the moisture of the semi-dried potato during a time

Oil Absorption

Fig. 7 shows the amount of oil absorption of semi-dried potatoes during 60 days of storage. Application of edible coatings on the product caused a significant decrease in oil absorption ($p<0.05$). This decrease can be attributed to the barrier properties against water vapor in different concentrations, which ultimately causes an effect on moisture and oil absorption (Abbasi *et al.*, 2015). The highest amount of oil absorption in both types of coating was estimated on day 60. On this day, the lowest moisture in the product was seen in both types of coating, which indicates the inverse relationship between moisture and oil absorption. On the other hand, the control sample had the lowest amount of moisture, which showed the highest oil absorption due to the inverse relationship between moisture and oil absorption. The interaction effect of time and concentration was also significant ($p<0.05$). The results showed that the amount of oil absorption in potato product covered by whey concentrate was less than that of the other coating. There was no significant difference between potato products covered by these two types of proteins ($p>0.05$).

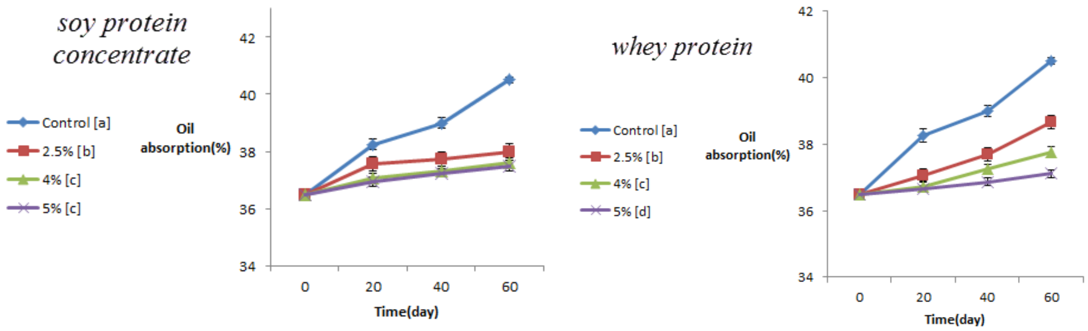

Fig. 7. The effect of soy protein concentrates and whey coating on oil absorption of the semi-dried potato during a time

Texture Crispness

Fig. 8 shows the effect of different concentrations of soy protein concentrate and whey protein on potato crispiness for 60 days. The use of protein coatings caused a significant decrease in the crispiness of the products ($p<0.05$). This may happen because a soft crust forms when the coating solution is applied. This top crust hardens during frying at high temperatures (Deo *et al.*, 2023). On the other hand, as mentioned previously, the control sample had less moisture. As the moisture content of the sample decreases, it becomes more brittle (Zielinska *et al.*, 2020). The interaction effect of time and concentration was also significant ($p<0.05$). The results showed that potatoes coated with soy protein concentrate had less crispness than samples coated with whey protein. The differences in surface properties of two coating proteins may explain this phenomenon (Jeon *et al.*, 2023).

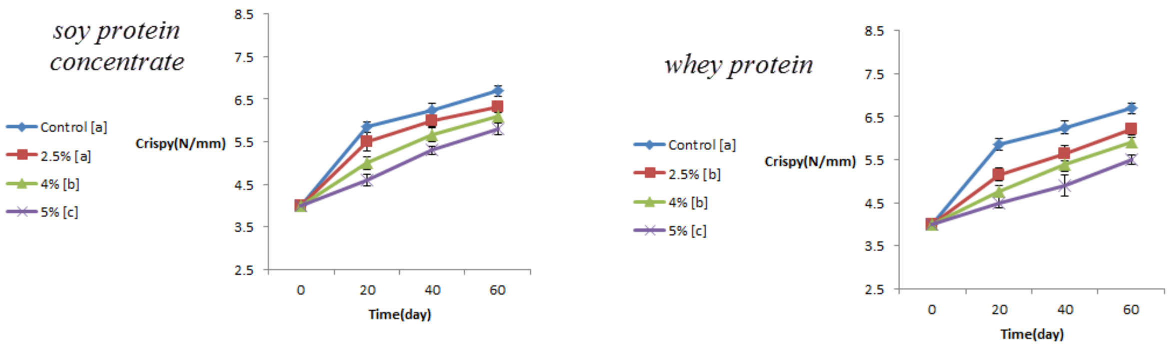

Fig. 8. The effect of soy protein concentrates and whey coating on the crispiness of the semi-dried potato during a time

Sensory Test

The sensory properties of coated semi-dried potato, including texture, taste, color, and overall acceptance, were evaluated. In both types of coatings, the concentration of 5% received the lowest score for texture (Fig. 9), which can be related to the crispiness of the product. The results regarding crispiness also indicated that using 5% concentration reduced the crispiness of the final product. The texture scores of the product on the 20th day and the first day were the lowest and the highest, respectively. Also, there was no significant difference between the samples covered with 2.5% whey protein and the control sample ($p>0.05$). The interaction effect of concentration and time was also significant ($p<0.05$).

Sensory judges evaluated the taste of the semi-dried potatoes over a storage period of 60 days. The application of the coating in the potato product at a concentration of 5% received the highest score from the sensory judges, and no significant difference was seen in the samples coated with soy protein concentrate at concentrations of 4 and 5% (Fig. 9) ($p > 0.05$). Potatoes coated with 2.5% soy protein concentrate scored lowest on the 20th day. The interaction effect of time and concentration was significant ($p<0.05$).

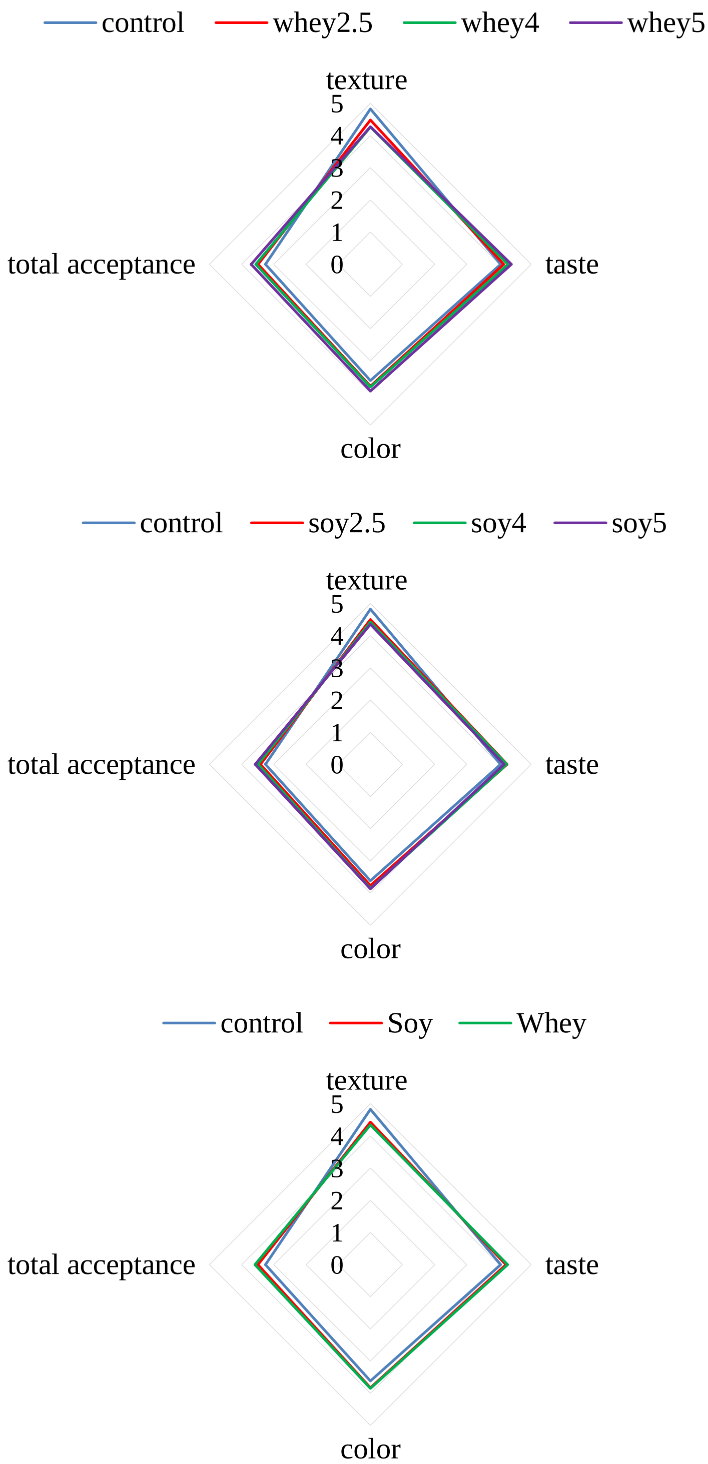

Fig. 9. The effect of soy protein concentrates and whey coating on sensory properties of the semi-dried potato during 60 days of storage

Color was another index investigated in the sensory test. The color scores showed that concentration was a compelling factor in this index, and the control sample got the lowest score. However, there was no significant difference between the control samples and potatoes with 2.5% whey protein coating. Potatoes coated with 4 and 5% soy protein also showed no significant difference ($p < 0.05$). The lowest color score in both coatings was estimated for the control sample on day 40.

The highest overall acceptance score in potato products in both types of coatings was related to the concentration of 5%; however, no significant difference was seen in the case of soy protein concentrate in concentrations of 2.5% and 4% (Fig. 9). The overall acceptance scores of potato samples decreased significantly during storage time ($p<0.05$). The interaction effect of storage time and concentration was significant ($p<0.05$).

Conclusion

As consumer awareness grows regarding environmental issues, there will be a shift towards more sustainable food preservation methods. Edible coatings, being biodegradable and derived from natural sources, are well-positioned to meet this demand. The research highlights the potential of plant-based coatings, which aligns with the global trend toward reducing plastic waste in food packaging. This study used soy protein concentrate and whey protein to coat semi-dried potatoes. The study evaluated the chemical, physical, and oil absorption properties of the coated potatoes during a 60-day storage period. Protein coatings caused the potato product to have higher moisture content than the control sample, and as a result, these coatings caused less oil absorption in the potato samples. The moisture content of semi-dried potatoes coated with soy protein concentrate was higher than that of samples coated with whey protein. The oil absorption of potato samples coated with soy protein concentrate was lower than the oil absorption of those coated with whey protein. The results proved the maintenance of ascorbic acid by coating the potatoes with proteins. In addition, coatings prevented the formation of reducing sugars in potatoes. Semi-dried potato sticks coated with soy protein concentrate and whey protein had more starch than the control samples. Soy protein concentrate and whey protein as coatings for semi-dried potatoes improved water reabsorption of potatoes during 60 days of storage. The rehydration of potatoes coated with whey protein was higher than that of soy protein concentrate. Both coatings reduced the crispness of the final product. According to the sensory evaluation, the overall acceptance score of the coated potatoes was higher than the control samples, although there was no significant difference between the two coatings. The results showed no significant difference between potatoes coated with soy protein and those coated with whey protein. However, all the investigated properties except the degree of crispness improved with increasing concentrations of both proteins. Therefore, it is recommended to use soy protein or whey protein at a concentration of 5% for coating potato slices. Future studies may focus on incorporating additional functional ingredients into edible coatings, such as antimicrobial agents, antioxidants, or nutraceuticals. This could enhance the coatings' effectiveness in preserving food quality while providing health benefits. Research may focus on optimizing coating formulations tailored to specific produce or storage conditions. This could include using different concentrations of soy and whey proteins or combining them with other biopolymers to achieve the desired physicochemical properties. Researchers may explore advancements in coating application methods, including nano-coating technologies and ultrasound-assisted techniques to enhance film properties.

Author Contribution

Z. Moslehi, S. Bani: Data curation, investigation, methodology, writing the original draft. **M. Bolandi, S.H. Ziaolhagh:** Conceptualization, data curation, software, project administration, supervision, writing review, and editing.

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تأثیر پوشش‌های خوراکی حاوی کنسانتره پروتئین سویا/ پروتئین آب پنیر بر کیفیت خلال‌های نیمه‌خشک سیب‌زمینی

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چکیده

استفاده از پوشش‌های خوراکی یک رویکرد پایدار و سازگار با محیطزیست برای حفظ کیفیت غذا در طول ذخیره‌سازی می‌باشد. هدف از این تحقیق بررسی تأثیر پوشش خوراکی تهیه شده از کنسانتره پروتئین سویا و پروتئین آب پنیر در افزایش پایداری شیمیایی خلال‌های سیب‌زمینی در طول دوره نگهداری می باشد. از آنجایی که معمولا خلال‌های نیمه آماده سیب‌زمینی منجمد و در فریزر نگهداری می‌شوند، می‌توان با نیمه‌خشک کردن و کاهش رطوبت آنها، این محصول را در دمای یخچال نگهداری کرد. در این تحقیق تأثیر غلظت‌های مختلف (۲/۵، ۴ و ۵ درصد وزنی) کنسانتره پروتئین سویا و پروتئین آب پنیر بر برخی ویژگی‌های فیزیکوشیمیایی سیب‌زمینی نیمه‌خشک (رنگ، جذب آب خلال‌های خشک، قندهای احیاکننده، نشاسته، اسید اسکوربیک، رطوبت، جذب روغن، تردی بافت و خواص حسی) طی ۶۰ روز نگهداری مورد بررسی قرار گرفت. نتایج نشان داد که سیب‌زمینی نیمه‌خشک پوشیده شده با کنسانتره پروتئین سویا و آب پنیر دارای بیشترین رطوبت و کمترین جذب روغن و ترد بودن نسبت به نمونه شاهد بود. تست حسی نمونه‌های پوشش داده شده با کنسانتره پروتئین سویا و آب پنیر با نمونه‌های بدون پوشش متفاوت بود و طعم سیب‌زمینی نیمه خشک با پوشش پروتئینی مورد قبول مصرف‌کنندگان قرار گرفت. پوشش‌های خوراکی اعمال‌شده تأثیر معنی‌داری بر اسید اسکوربیک و کاهش قند داشتند. کمترین و بیشترین مقدار نشاسته در نمونه‌های شاهد و پوشش داده شده مشاهده شد. این ویژگی‌ها نشان می‌دهد که پوشش‌های مبتنی بر کنسانتره پروتئین سویا و آب پنیر انتخابی عالی برای کاهش جذب روغن و افزایش ماندگاری خلال‌های نیمه‌خشک سیب‌زمینی هستند.

واژه‌های کلیدی: پروتئین آب پنیر، پروتئین سویا، پوشش‌های خوراکی، سیب‌زمینی خشک، عمر انباری

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