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Strength Properties of Coated Paper with *Cuminum cyminum* L. and *Prunus mahaleb* L.

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Abstract

Coating of the paper surface against to microorganism to making it suitable for food packaging is crucial in terms of improving antimicrobial properties. *Cuminum cyminum* L. known as cumin and *Prunus mahaleb* L. have the abundant chemical compound. Cumin has antiviral activity that making it proper for coating due to its various components. Mahaleb as well has rich fragrance make it eligible for sugary snacks and chocolate package. After coating with such biomaterials, thanks to varied fatty acids impart protective feature from oxidation to paper surface. It was observed that the odor of substances was trapped from paper samples. Wrapping paper selected as a base paper in this study. Cationic starch used for emulsifying the coating chemical. Cumin and mahaleb added the starch emulsion and coating suspension applied on the top pile of the paper with # 0 drawdown bar. Coating application reduced the paper's tear index results but increase tensile and burst index results in both cases. Mahaleb gives better Cobb₆₀ value and bursting and tensile index and comparing to Cumin. However, cumin coated papers tensile index results in machine direction was better than mahaleb. Both natural substances are suitable material as an additive to the coating.

Keywords: Paper coating, natural pigment, mahaleb and cumin coating.

1. Introduction

Paper packaging products, convenient for the food industry. Paper is a natural carbohydrate polymer made from substantially cellulose. Their unique porous structure provides lightweight, durable features besides coating material could apply with ease and quickly dry. Impart antimicrobial properties to the nutrition's where contact the paper surface is field that receiving it is worth mentioning attention to various research. Coating of the paper surface making available for food contact packaging is significant in terms of favoring antimicrobial properties. As paper have hygroscopic structure, it is weak against water vapor, gases and oils. Synthetic polymers like PVA, latex etc. generally utilized for developing the barrier features of paper and paperboards. This kind of substances fill the gaps in paper and paperboards provide the density of materials. Surfaces developed by using environment-friendly renewable biodegradable materials in recent years rather than those synthetic substances [1].

Many experts have designed to test antimicrobial packaging materials against bacteria, fungi and several microorganisms. According to previous studies, due to extend the shelf life of nutrition's, essential oils could use as antimicrobial substances [2]. Cinnamon essential oil is one of them. Results showed that compared to control samples; coating with cinnamon to paper packaging surface extends the shelf life of bread [3]. In addition to essential oils, natural bioactive agents are also using as coatings [4,5]. These are often found on paper and board

packaging applications for the food industry; Chalier et.al. shows that soy protein contains carvacrol coated papers release carvacrol substance prolong with relative humidity and temperature [6]. Another material is paraffin-based coating agents that could extend the shelf life too [7,8]. Coated with carvacrol nanoclay-wheat gluten papers increased film barrier properties and stability during manufacturing [9]. Chitosan is natural material also and there are lots of study about Chitosan-Coated Paper [10]. Evaluating the improvement of water vapor permeability of chitosan wax coated paper is one of them [11]. Coating both of the surface with the chitosan-caseinate exhibited reduction in water vapor permeability [12]. When used as a filler material, chitosan films enhanced water resistance [13]. Similar results obtained investigations [14] and [15] in terms of oil proof papers, which coated with chitosan. Besides Encapsulate with β -cyclodextrin garlic oil for packaging application subjected of another study [16]. It is proven in a study that partially control microbial degradation with silver ions [17]. All this inorganic antimicrobial efficiency achieved for food contact paper materials with coating application. Substrate or base layer controls mechanical features of the coating. Still, tensile features of coated papers depend on coating weight [18].

Besides, it is also critical to control the surface of the paper against liquids. The paper surface should absorb the coating material equally. The Cobb₆₀ test evaluates water absorption value by the paper sample during the test period. Cobb₆₀ also used an indicator of the degree of

sizing of paper [18]. After surface sizing with starch it was determined that some of strength properties of paper increased [19]. Similar results obtained from current article. Coated papers weight increases from 5 to 16 g/m² results that increase to elongation value around 5% [12].

1. Materials and Methods

1.1 Preparation of Natural Pigments

Cumin and mahaleb bought in closed vacuum packages. Dry matter amount of powdered substances determined. Powders filtered with 100-mesh screen and kept in drying oven in 60°C for an hour.

1.2 Preparing the Paper Coating Substances

4.5% (w/w) of starch cooked at 95°C, and then 5.16% (w/w) cumin and 5.21% (w/w) mahaleb added separately when starch was cool down at 30°C. Distilled water used in all processes. All paper surface single side coated with using # 0 bar by coating applicator (Film coater model K202 from RK print coat instrument). The applicator speed was 3 cm/s.

1.3 Determination of Paper Strength Properties

Paper strength tests performed in Istanbul University, Faculty of Forestry, Department of The Chemistry and Technology of Forestry Products SEKKA Laboratory. Zwick Universal Test machine used for evaluate to bursting strength (ISO 2758) and tensile strength (ISO 1924-2). Tear strength (ISO 1974) evaluated in Elmendorf test machine. Cobb₆₀ results measure according to ISO 535. After kept 24 hours in the conditioning room, paper tests obtained. Standard method was ISO 287.

2. Results and Discussion

2.1 Tests Results of Paper Samples

Basis weight changes and Cobb₆₀ results in paper samples were in Table 1 and 2 coating amounts resulted in targeted weight gain.

Table 1. Basis Weight of the Paper Samples.

Coating Material	Grammage (g/m ²)
None	50.00
Starch	54.10
Cumin	59.70
Mahaleb	59.97

Table 2. Water Absorption (Cobb₆₀) Results of Untreated and Treated Papers.

Coating Material	Cobb ₆₀ Value (g/m ²)
None	21.00
Starch	16.25
Cumin	15.16
Mahaleb	18.70

The difference between cumin and mahaleb due to the viscosity.

Table 3. Tensile Index Values of the Paper Samples.

Coating Material	M.D. Tensile Index (N.m ² /g)	C.D. Tensile Index (N.m ² /g)
None	62.16	32.19
Starch	61.71	35.06
Cumin	62.42	34.28
Mahaleb	63.89	36.74

Table 4. Bursting Index and Tear Index Values of the Paper Samples.

Coating Material	M.D. Tear Index (mN.m/g)	C.D. Tear Index (mN.m/g)	Bursting Index (kPa)
None	4.12	5.12	75.11
Starch	3.66	4.85	79.43
Cumin	3.59	4.91	78.09
Mahaleb	3.46	5.01	79.85

Coating process forms a conservative layer on the paper surface, hence coated paper gains resistance against bursting and tensile. Tear Index value reduced with coating partly because of damaged hydrogen bonding between the fibers (Table 3 and 4). Machine direction (M.D.) were less increase than cross direction (C.D.) in tensile and tear index values.

4. Conclusion

It could be expected that increasing treatment level with a cationic starch in the paper coating application. Starch has increased burst index properties especially Cobb₆₀ values itself. Although the present results indicate, mahaleb has a positive impact in terms of Cobb₆₀ value. In addition, the natural basic character of cumin is a sign of a suitable coating polymer. Nevertheless, despite cumin strong acidic character does not prevent their use as a coating agent. Despite Cuminaldehyde is a constituent of the cumin has antiviral properties, it should be examined for the availability of food contact materials because of the strong odor. Appear encouraging in this regard; suitability for food contact packaging of cumin could be the subject of another research. Results related to strength properties, tear index obtained for reduced by coating. Effects were generally consistent with wetting and drying process repeatedly, the nature of coating application, which destructive effect to fiber-fiber bounding. On the contrary, due to coating materials filling of the gaps in the paper, tensile index and burst index values were increased.

This study has a precaution in terms of the shelf life extension studies of nutrition. It envisaged that the cumin and mahaleb powder could successfully applied in wrapping paper in contact with food.

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