Plant extracts for improving the properties of packaging papers

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ABSTRACT: This work explores the possibilities of using plant extracts to improve the properties of packing papers for active packaging. Active packaging is designed to extend the shelf life of food products while maintaining the characteristics of the inner packaging environment within certain limits. Thus, active packing technology for foods leads to expanding packaging functions. Researchers and manufacturers interest is based on the possibility of incorporating biologically active substances from herbs in wrapping paper to impart antibacterial and barrier properties of the paper.

The aim of this study was to obtain and test paper wrapping materials with plant extracts containing biologically active substances. The substances were obtained from widely found in Bulgaria, herbs - St. John's Wort, Kim, Rosemary, Thyme and Basil. The resulting plant extracts of the different herbs were used as surface treatment of different packaging papers. Processed papers are microbiologically and mechanically tested to determine their properties and the capabilities to be used as an active packaging.

The results of the analysis of the resulting packaging papers show the possibility of using plant extracts with biologically active ingredients to produce papers with barrier properties from which active packs can be obtained.

➤ EXPERIMENTAL

St. John's Wort
(*Hypericum perforatum L.*)
The herb has antiseptic as well as bactericidal properties. Contains volatile substances that have a pronounced antibacterial effect.

Thyme
(*Thymus vulgaris L.*)
Thyme is a perennial herb, rich in various nutrients. The herb contains carvacrol and thymol.

Rosemary
(*Rosmarinus officinalis L.*)
Rosemary, and in particular the colored tops, contain antibacterial and antioxidant rosmaric acid.

Basil
(*Ocimum basilicum L.*)
Basil has an antiseptic, antispasmodic, anti-inflammatory effect and is also highly antibacterial.

Cym
(*Carum carvi L.*)
It has a sharp aniseed flavor and taste. The aroma is from ethereal oils - mainly from carvone and lemon.

• Obtaining plant liquid extracts

Plant liquid extracts were prepared by solving herbs in 70% ethanol. Static extractions were performed at a ratio of raw material to solvent of 1:10; process temperature 60 °C; duration 5 h. Separation of the raw material from the obtained extracts was by filtration through filter paper.
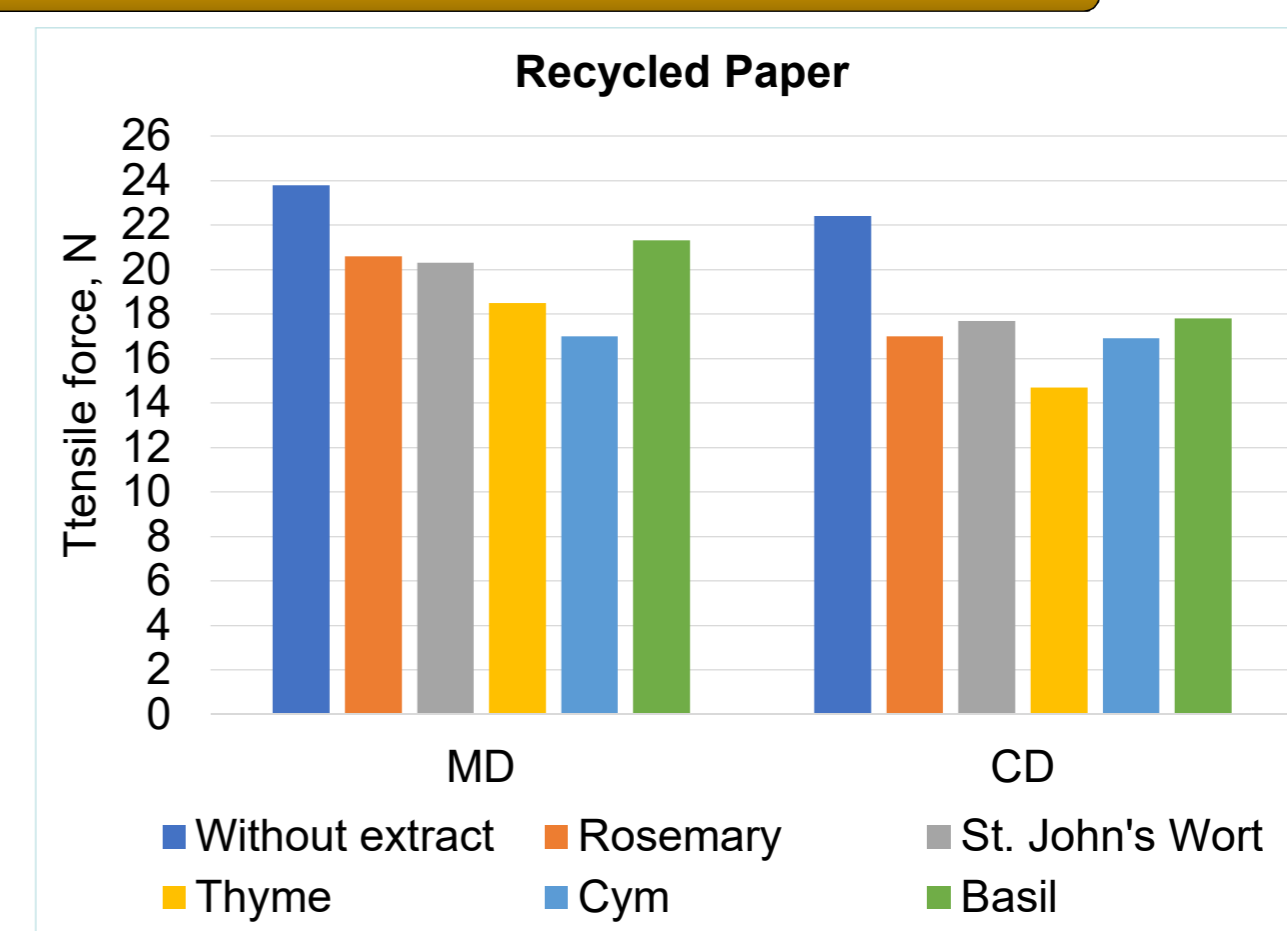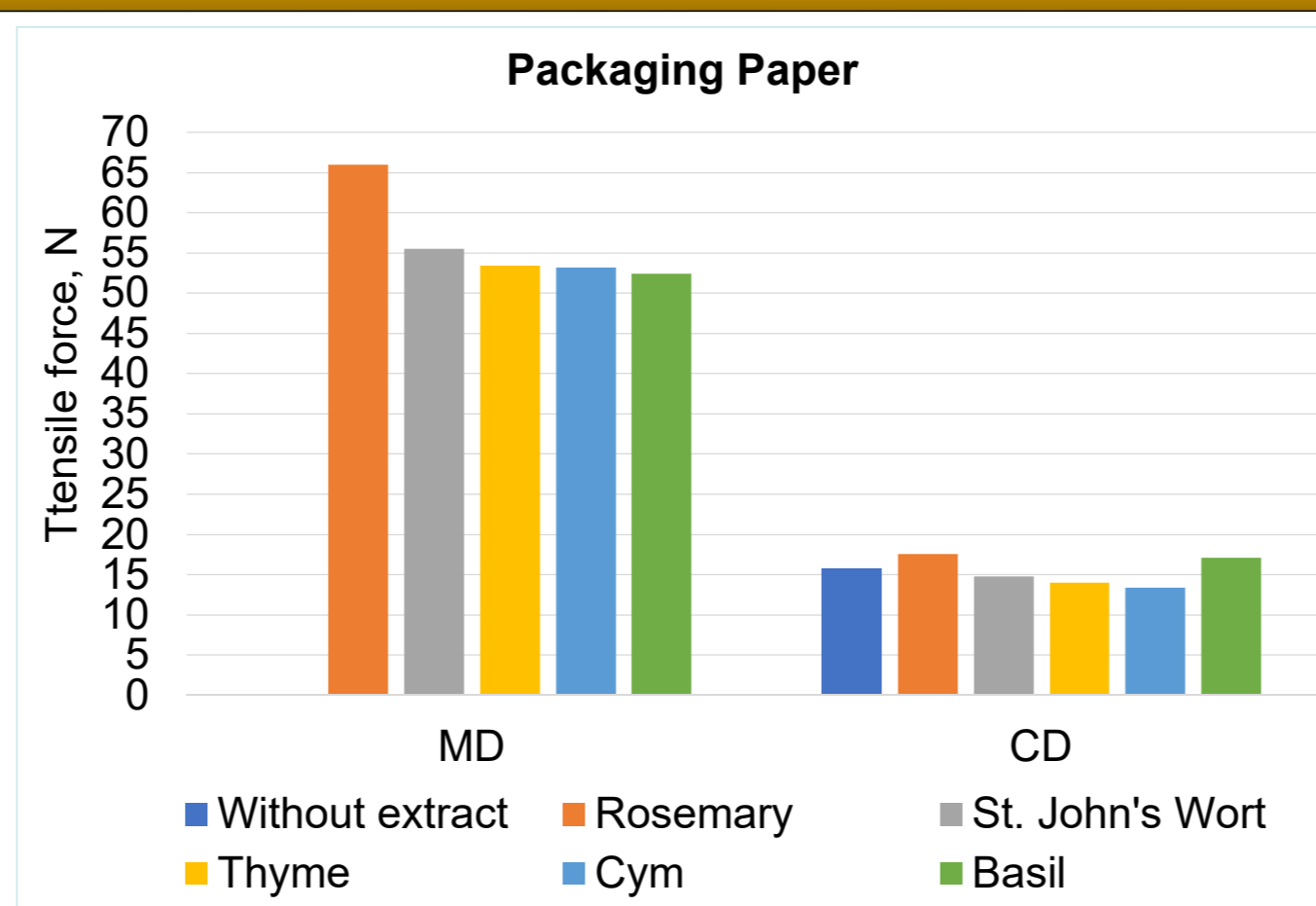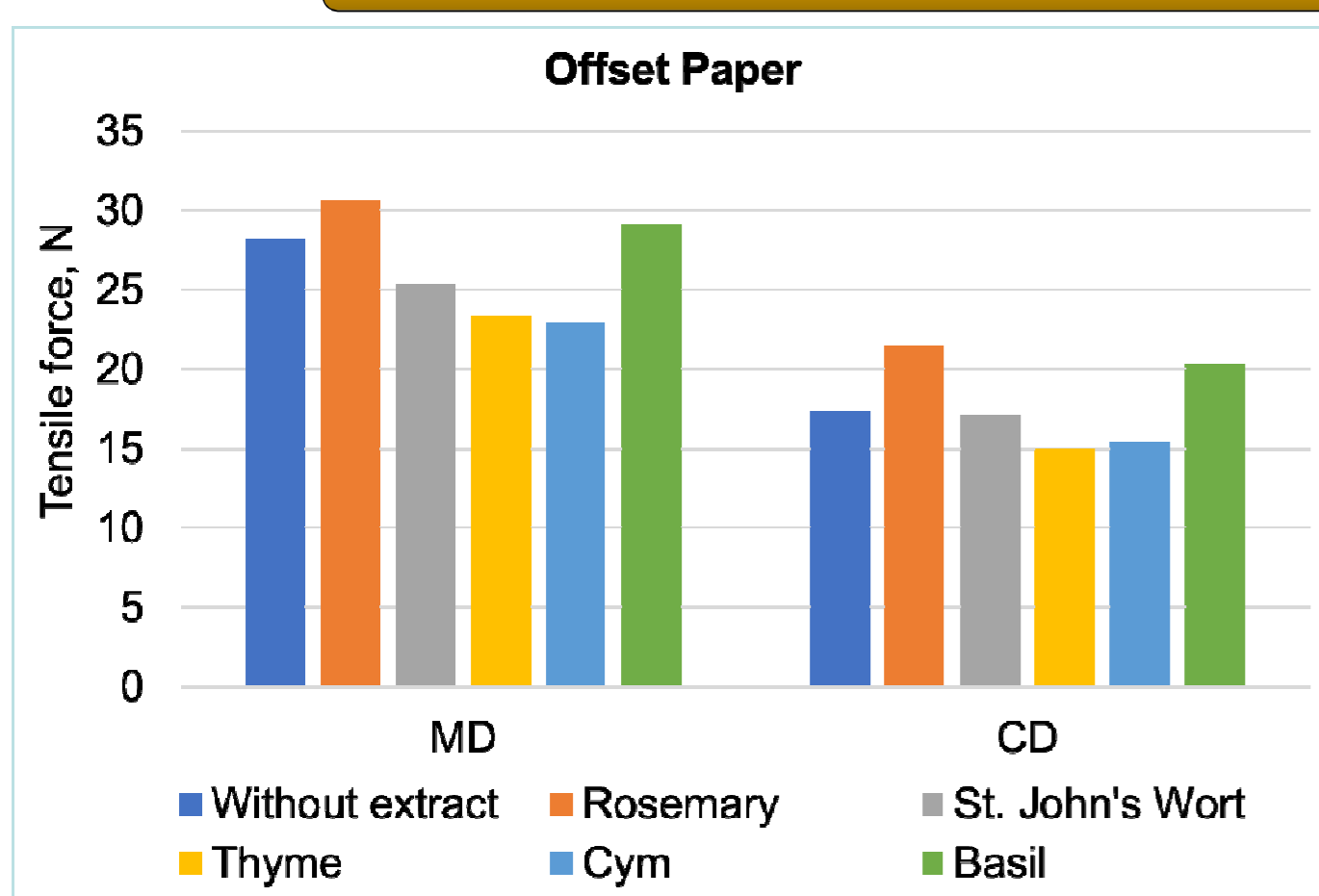
• Plant extracts at surface application

Paper ➤ 🧴 ➤ Both sides

• Antibacterial properties of treated paper samples

Offset paper treated with	Test - microorganisms	Total number of viable microorganisms (кое/mL)	Processing efficiency (%)
-	-	90	-
-	*Staphylococcus aureus*	3,8x10^5	-
-	*Bacillus subtilis*	3x10^5	-
-	*Salmonella abony*	6x10^5	-
Cym	-	174	-
	Staphylococcus aureus	3,3x10^5	13,4
	Bacillus subtilis	2,1x10^5	30,0
	Salmonella abony	2,7x10^5	55,0
Basil	-	0	-
	Staphylococcus aureus	3,6x10^5	5,3
	Bacillus subtilis	2,4x10^5	20,0
	Salmonella abony	4,4x10^5	26,7
Rosemary	-	4	-
	Staphylococcus aureus	9,1x10^4	76,1
	Bacillus subtilis	8,4x10^4	72,0
	Salmonella abony	9,6x10^4	84,0
Thyme	-	18	-
	Staphylococcus aureus	3,4x10^5	10,5
	Bacillus subtilis	2,9x10^5	3,3
	Salmonella abony	4,5x10^5	25,0
St. John's Wort	-	8	-
	Staphylococcus aureus	3,8x10^5	0
	Bacillus subtilis	2,7x10^5	10,0
	Salmonella abony	3,7x10^5	38,3

Packaging Paper treated with	Test microorganisms	Total number of viable microorganisms (кое/mL)	Processing efficiency (%)
-	-	210	-
-	*Staphylococcus aureus*	2,3x10^5	-
-	*Bacillus subtilis*	4x10^5	-
-	*Salmonella abony*	3,1x10^5	-
Cym	-	140	-
	Staphylococcus aureus	1,6x10^5	30,4
	Bacillus subtilis	1,9x10^5	52,5
	Salmonella abony	2,6x10^5	16,1
Basil	-	200	-
	Staphylococcus aureus	1,7x10^5	26,1
	Bacillus subtilis	3,1x10^5	22,5
	Salmonella abony	2,1x10^5	32,3
Rosemary	-	60	-
	Staphylococcus aureus	6x10^4	74
	Bacillus subtilis	8,6x10^4	78,5
	Salmonella abony	9,2x10^4	70,3
Thyme	-	230	-
	Staphylococcus aureus	2,2x10^5	4,4
	Bacillus subtilis	2x10^5	50
	Salmonella abony	1,9x10^5	38,7
St. John's Wort	-	190	-
	Staphylococcus aureus	2,1x10^5	8,7
	Bacillus subtilis	1,3x10^5	67,5
	Salmonella abony	1,5x10^5	51,6

Recycled paper treated with	Test - microorganisms	Total number of viable microorganisms (кое/mL)	Processing efficiency (%)
-	-	110	-
-	*Staphylococcus aureus*	2x10^5	-
-	*Bacillus subtilis*	5x10^5	-
-	*Salmonella abony*	4,5x10^5	-
Cym	-	804	-
	Staphylococcus aureus	1,7x10^5	15
	Bacillus subtilis	3x10^5	50
	Salmonella abony	2,5x10^5	44,5
Basil	-	28	-
	Staphylococcus aureus	1,3x10^5	50
	Bacillus subtilis	4,3x10^5	14
	Salmonella abony	4,1x10^5	8,9
Rosemary	-	0	-
	Staphylococcus aureus	4x10^4	80
	Bacillus subtilis	1,7x10^5	66
	Salmonella abony	3,6x10^5	20
Thyme	-	123	-
	Staphylococcus aureus	4x10^5	50
	Bacillus subtilis	3,2x10^5	36
	Salmonella abony	4,1x10^5	8,9
St. John's Wort	-	10	-
	Staphylococcus aureus	1,8x10^5	10
	Bacillus subtilis	4,2x10^5	16
	Salmonella abony	3,8x10^5	15,6

• Tensile Force, N acc. ISO 1924-2:2008

Offset Paper — Tensile force, N (MD, CD); Legend: Without extract, Rosemary, St. John's Wort, Thyme, Cym, Basil

Packaging Paper — Tensile force, N (MD, CD); Legend: Without extract, Rosemary, St. John's Wort, Thyme, Cym, Basil

Recycled Paper — Tensile force, N (MD, CD); Legend: Without extract, Rosemary, St. John's Wort, Thyme, Cym, Basil

➤ CONCLUSON

➤ The extracts of the Bulgarian herbs were **successfully** used **in surface application**.

➤ **The examined paper samples, which were treated with rosemary extract had the largest antibacterial activity.**

➤ The results show **possibility** of obtaining **packaging papers** with antibacterial properties **with herb extracts** to be used **for active packaging.**