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# FORTIFICATION OF SWEETENED FRUIT PUREE WITH DRY EXTRACT OF RASPBERRY PRESS CAKE

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## INTRODUCTION

THE FOOD INDUSTRY TREND IS MOVING TOWARDS FOODS THAT NOT ONLY TASTE GOOD BUT ARE ALSO BENEFICIAL TO HUMAN HEALTH. FUNCTIONAL FOODS ARE AN EXCITING CURRENT TREND IN THE FOOD AND NUTRITION FIELD. BY-PRODUCTS FROM BERRY PROCESSING (PRESS CAKE/POMACE) ARE RICH SOURCES OF HEALTH-BENEFICIAL COMPOUNDS [1,2]. THE ADDITION OF BERRY PRESS CAKE CONSTITUENTS TO FOOD PRODUCTS MAY SIGNIFICANTLY INCREASE THE LEVELS OF IMPORTANT PHYTONUTRIENTS IN THE HUMAN DIET. THEREFORE THE AIM OF THIS INVESTIGATION WAS TO ASSESS HOW THE EXTRACT ADDITIVE AFFECTS THE CHEMICAL COMPOSITION AND COLOR AS WELL AS ANTIRADICAL AND SENSORY PROPERTIES OF FRUIT PUREE.

## MATERIALS AND METHODS

PEAR/APPLE/YELLOW CHERRY PLUM PURE WAS PREPARED BY BLENDING 20% OF PEAR PUREE, 10% OF APPLE PUREE AND 20% OF YELLOW CHERRY PLUM PUREE, AND ADDING 50% OF SUCROSE SYRUP (30 °BRIX). DIFFERENT AMOUNTS OF POWDERED RASPBERRY PRESS CAKE EXTRACT (EXTRACTED AT 50°C WITH 80% ETHANOL) WERE ADDED TO BLENDED FRUIT PUREE (0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 AND 2%) AND THEN PUREES WERE HEATED UP TO 85±5°C WHILE MIXING THEM CONSTANTLY. HEATED AND PROPERLY MIXED PUREES WERE POURED TO 500 ml JARS AND PASTEURIZED FOR 20 MIN AT 85±2°C. SIMULTANEOUSLY, CONTROL SAMPLE (FRUIT PUREE WITHOUT EXTRACT ADDITIVE) WAS SUBJECTED TO THE SAME TREATMENT. THE PASTEURIZED PUREES WERE SEALED WITH METAL COVERS AND KEPT IN THE DARK ROOM AT AMBIENT TEMPERATURE UNTIL NEEDED (APPROX. 2 WEEKS).

THE TOTAL PHENOLICS CONTENT (TPC) WAS DETERMINED WITH FOLIN–CIOCALTEU REAGENT, USING GALLIC ACID AS A STANDARD [3]. THE ANTIRADICAL ACTIVITY WAS DETERMINED BY DPPH RADICAL SCAVENGING ASSAY [4] AND EXPRESSED AS TROLOX EQUIVALENT ANTIOXIDANT CAPACITY (TEAC). THE pH DIFFERENTIAL METHOD WAS USED FOR ANTHOCYANIN DETERMINATION [5]. ELLAGITANNINS WERE QUANTIFIED AS ELLAGIC ACID EQUIVATENTS AFTER ACID HYDROLYSIS OF THE EXTRACTS. FREE ELLAGIC ACID WAS ANALYZED IN NON-HYDROLYZED SAMPLES. ELLAGIC ACID AND ITS DERIVATIVES WERE DETERMINED BY RP-HPLC [6].THE COLOR OF THE PUREES WAS MEASURED WITH MINISCANXE PLUS SPECTROPHOTOMETER. SENSORY EVALUATION (THE ACCEPTANCE TESTING AND THE SENSORY PROFILE TEST) OF FRUIT PUREES WAS CARRIED OUT AT THE SENSORY ANALYSIS LABORATORY OF FOOD INSTITUTE OK KAUNAS UNIVERSITY OF TECHNOLOGY

## RESULTS AND DISCUSSION

ONE GRAM OF DRY RASPBERRY PRESS CAKE EXTRACT WHICH WAS ADDED TO THE FRUIT PUREE CONTAINED 5.54± 0.20 mg OF ANTHOCYANINS, 121.13 ± 1.52 mg OF TPC, 1.93 ± 0.05 mg OF FREE ELLAGIC ACID AND 20.65±1.10 mg OF ELLAGITANNINS.

IN THIS STUDY THE INFLUENCE OF PROCESSING AND THERMAL TREATMENT ON THE FRUIT PHENOLICS (FROM WHICH THE FRUIT PUREE WAS MADE) WAS NOT EVALUATED.

THE TPC OF PUREE INCREASED GRADUALLY AS THE CONCENTRATION OF PRESS CAKE EXTRACT ADDITIVE INCREASED. THE TPC OF THE PUREE INCREASED FROM 108.8 mg/100g (CONTROL) TO 345.8 mg/100g (2% PRESS CAKE EXTRACT ADDITIVE) (TAB. 1).

ANTHOCYANINS CONTENT, DUE TO THE ADDITION OF RASPBERRY PRESS CAKE EXTRACT, IN THE PUREE INCREASED FROM 0 (CONTROL) UP TO 8.3 mg/100g (PUREE WITH 2% PRESS CAKE EXTRACT ADDITIVE). THE RECOVERIES OF ANTHOCYANINS IN THE FRUIT PUREE RANGED FROM 70 TO 86% OF THE CONTENT PRESENT IN THE RASPBERRY PRESS CAKE EXTRACT (TAB. 1).

THE RASPBERRY PRESS CAKE EXTRACT ADDITIVE ENRICHED THE FRUIT PUREE WITH ELLAGIC ACID AND ELLAGITANNINS. THE CONTENT OF ELLAGITANNINS FOUND IN FRUIT PUREES WAS UP TO 11% LOWER THAN THE CONTEND FOUND IN THE RASPBERRY PRESS CAKE EXTRACT (TAB. 1). THE FREE ELLAGIC ACID CONTENT IN THE PREPARED PUREES WAS FROM 30 TO 44% HIGHER THAN THE CONTENT OF FREE ELLAGIC ACID FOUND IN THE ADDED RASPBERRY PRESS CAKE EXTRACT (FIG. 1). THE INCREASE OF FREE ELLAGIC ACID IN THE PRODUCT WAS RELATED TO A PARTIAL HYDROLYSIS OF ELLAGITANNINS.

THE TEAC VALUE OF THE PEAR/APPLE/YELLOW CHERRY PLUM PUREE WITH 2% PRESS CAKE ADDITIVE WAS 3.9 TIMES HIGHER THAN THAT OF THE PUREE WITHOUT ADDITIVE (FIG. 2).

THE EXTRACT ADDITIVE REDUCED THE LIGHTNESS (L*) AND THE YELLOWNESS (b*), AND INCREASED THE REDNESS (a*) OF THE PEAR/APPLE YELLOW CHERRY PLUM PUREE (TAB. 2.). THE TOTAL COLOR DIFFERENCE (ΔE) BETWEEN THE CONTROL PUREE AND PUREES WITH EXTRACT ADDITIVE INDICATE THAT THE EXTRACT ADDITIVE HAD A STRONG IMPACT ON THE COLOR OF THE PUREE.

THE COLOR, ODOR AND TEXTURE OF ALL TESTED PUREES WERE EQUALLY ACCEPTABLE FOR THE PANELISTS. THE EXTRACT ADDITIVE MOST SIGNIFICANTLY INFLUENCED THE TASTE ACCEPTANCE OF THE PUREE (TAB. 3). THE TOTAL ACCEPTANCE OF THE FRUIT PUREE (WITHOUT SEPARATING ANY PARTICULAR PROPERTY) WAS SIGNIFICANTLY REDUCED WHEN THE EXTRACT CONCENTRATION EXCEEDED 1.4%. THE SENSORY PROFILING TEST REVEALED THAT BITTER TASTE AS WELL AS BITTER AND ASTRINGENT AFTERTASTES INCREASED WITH INCREASING PRESS CAKE EXTRACT ADDITIVE CONCENTRATION IN THE PUREE (FIG. 3). THE PUREES WITH THE EXTRACT CONCENTRATION OF 1.6% OR HIGHER WERE ACKNOWLEDGED AS BEING UNSUITABLE FOR CONSUMPTION.

**TAB. 1.** TOTAL PHENOLICS, ANTHOCYANINS AND ELLAGITANNINS CONTENT OF FRUIT PUREES

| Extract concentration, % | Phenolics, mg/100g | | Anthocyanins, mg/100g | | Ellagitannins, mg/100g | |
|---|---|---|---|---|---|---|
| | Calculated[a] | Recovered[b] | Calculated[a] | Recovered[b] | Calculated[a] | Recovered[b] |
| 0 | 108.8 | 108.8±9.48 | – | – | – | n.d. |
| 0.2 | 133.1 | 135.7±5.94 | 1.1 | 0.9±0.22 | 4.1 | 3.7±0.32 |
| 0.4 | 157.4 | 159.9±4.10 | 2.2 | 1.8±0.15 | 8.3 | 7.5±0.81 |
| 0.6 | 181.6 | 181.8±7.39 | 3.3 | 2.8±0.32 | 12.4 | 11.1±0.94 |
| 0.8 | 205.9 | 202.9±0.84 | 4.4 | 3.5±0.34 | 16.5 | 15.0±1.16 |
| 1.0 | 230.1 | 224.8±5.20 | 5.5 | 3.9±0.40 | 20.6 | 18.7±1.23 |
| 1.2 | 254.4 | 253.2±4.82 | 6.6 | 4.9±0.44 | 24.8 | 22.1±0.52 |
| 1.4 | 278.7 | 277.5±5.74 | 7.8 | 5.6±0.24 | 28.9 | 26.2±0.76 |
| 1.6 | 302.9 | 296.9±3.69 | 8.9 | 6.2±0.30 | 33.0 | 30.1±1.30 |
| 1.8 | 327.2 | 322.4±6.58 | 10.0 | 7.2±0.29 | 37.1 | 32.9±1.22 |
| 2.0 | 351.5 | 345.8±8.00 | 11.1 | 8.3±0.16 | 41.3 | 37.4±1.62 |

[A]THE SUM OF THE AMOUNT FOUND IN THE PREPARED PUREE WITHOUT EXTRACT ADDITIVE AND THE AMOUNT ADDED WITH THE MARC EXTRACT; [B]THE AMOUNT FOUND IN THE FINAL PRODUCT

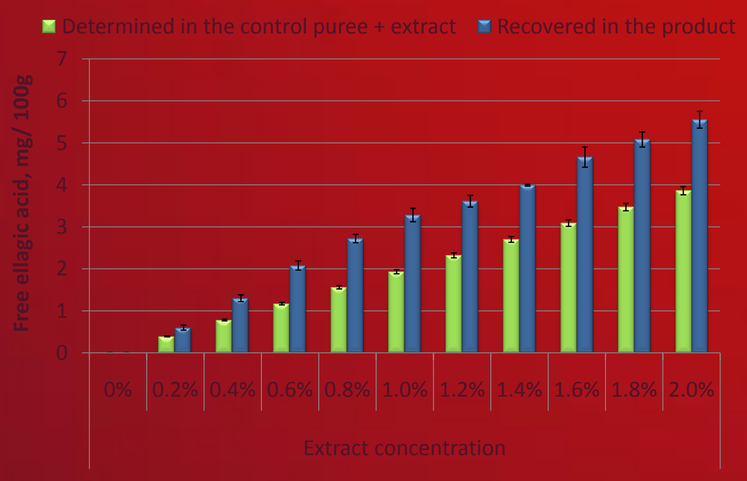


**FIG. 1.** FREE ELLAGIC ACID CONTENT OF FRUIT PUREES

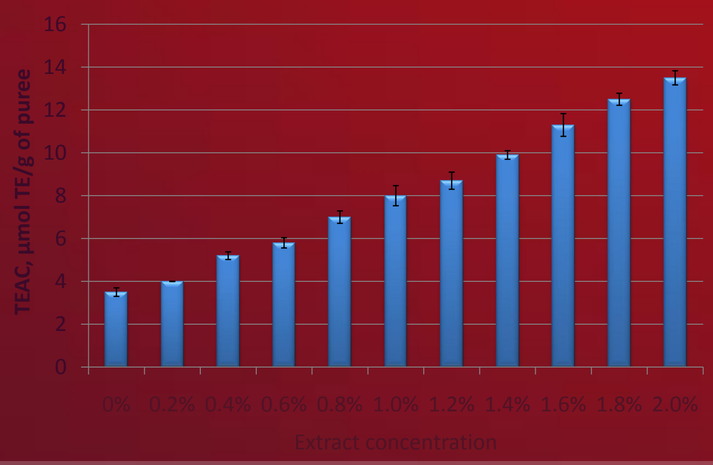


**FIG. 2.** RADICAL SCAVENGING CAPACITIES AS TEAC OF FRUIT PUREES

**TAB. 2.** CIEL*a*b* COLOR PARAMETERS OF FRUIT PUREES

| Extract concentration, % | L* | a* | b* | ΔE |
|---|---|---|---|---|
| 0 | 41.58±0.05 | 3.69±0.09 | 14.13±0.10 | – |
| 0.4 | 38.93±0.07 | 7.10±0.14 | 10.67±0.20 | 5.53 |
| 0.8 | 37.39±0.04 | 9.11±0.10 | 9.27±0.07 | 8.40 |
| 1.2 | 36.45±0.01 | 10.37±0.04 | 8.28±0.12 | 10.26 |
| 1.6 | 35.46±0.14 | 11.03±0.09 | 7.47±0.19 | 11.65 |
| 2.0 | 35.31±0.03 | 12.49±0.05 | 7.25±0.09 | 12.81 |

**TAB. 3.** ACCEPTABILITY SCORES OF THE PEAR /APPLE/YELLOW CHERRY PLUM PUREES

| Extract concentration, % | Color | Odor | Taste | Texture | Total |
|---|---|---|---|---|---|
| | Points | | | | |
| 0.0 | 4.6[a] | 4.8[a] | 5.0[d] | 4.2 [a] | 4.8[d] |
| 0.2 | 4.2[a] | 4.7[a] | 4.8[d] | 4.2[a] | 4.6[cd] |
| 0.4 | 4.4[a] | 4.7[a] | 4.4[cd] | 4.4[a] | 4.6[cd] |
| 0.6 | 4.2[a] | 4.7[a] | 5.0[d] | 4.8 [a] | 4.8[cd] |
| 0.8 | 4.0[a] | 4.7[a] | 4.4[cd] | 4.6 [a] | 4.5[cd] |
| 1.0 | 4.0[a] | 4.6[a] | 4.1[bcd] | 4.6[a] | 4.2[bcd] |
| 1.2 | 4.2[a] | 4.6[a] | 3.9[bcd] | 4.6[a] | 3.9[abcd] |
| 1.4 | 4.8[a] | 4.6[a] | 3.4[abc] | 4.4[a] | 3.6[abc] |
| 1.6 | 4.8[a] | 4.4[a] | 3.2[ab] | 4.4[a] | 3.3[ab] |
| 1.8 | 4.8[a] | 4.4[a] | 3.0[ab] | 4.6[a] | 2.9[a] |
| 2.0 | 4.8[a] | 4.4[a] | 2.6[a] | 4.4[a] | 2.8[a] |

DIFFERENT LETTERS IN THE SAME COLUMN INDICATES SIGNIFICANT DIFFERENCES BETWEEN THE SAMPLES (P ≤ 0.05)

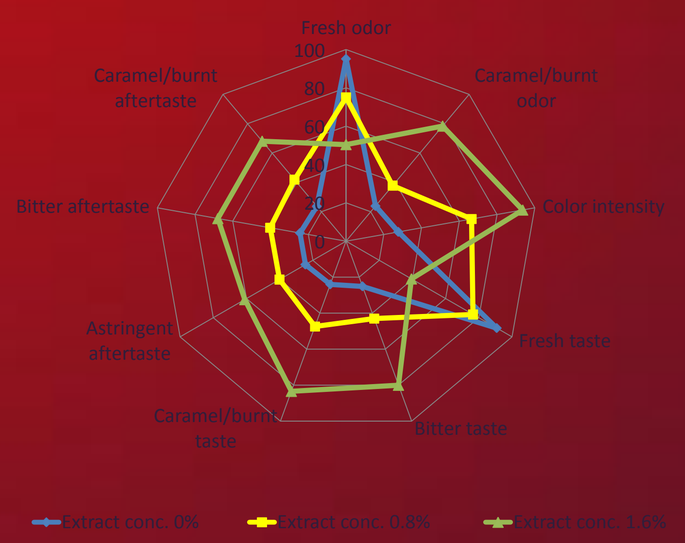


**FIG. 3.** THE INFLUENCE OF EXTRACT ADDITIVE ON SENSORY PROFILE OF PEAR /APPLE/YELLOW CHERRY PLUM PUREE

## CONCLUSSIONS

THE CONSTITUENTS OF ADDED RASPBERRY PRESS CAKE EXTRACT INCREASED THE ANTIRADICAL ACTIVITY OF FRUIT PUREE, THUS IMPROVING FUNCTIONAL PROPERTIES OF THE PRODUCT. THE PHENOLIC COMPOUNDS (ESPECIALLY COLORLESS PHENOLICS) OF THE RASPBERRY PRESS CAKE EXTRACT WERE WELL RETAINED DURING THE PRODUCTION PROCESS OF THE PUREE. THE INCREASE OF FREE ELLAGIC ACID (UP TO 44 %) IN THE FRUIT PUREES WITH EXTRACT ADDITIVE AFTER THERMAL TREATMENT WAS RELATED TO A PARTIAL HYDROLYSIS OF ELLAGITANNINS.

THE EXTRACT ADDITIVE MOST SIGNIFICANTLY INFLUENCED THE TASTE OF THE FRUIT PUREE. BITTER TASTE AS WELL AS BITTER AND ASTRINGENT AFTERTASTES INCREASED WITH INCREASING PRESS CAKE EXTRACT ADDITIVE CONCENTRATION IN THE PUREE. THE PUREES WITH A PRESS CAKE EXTRACT CONCENTRATION OF 1.6 % OR HIGHER WERE ACKNOWLEDGED AS BEING UNSUITABLE FOR CONSUMPTION.

## ACKNOWLEDGEMENT

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