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# Relationships Between Physicochemical Properties and Image Texture Features of Yellow Sweet Bell Pepper after Selected Periods of Spontaneous Lacto-fermentation

InHort INSTYTUT OGRODNICTWA

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## INTRODUCTION & AIM

**Lacto-fermentation** is an effective method for preserving sweet bell peppers after harvest. In addition to extending their shelf life, this process enhances the peppers with beneficial health properties.

**The objectives of this study were as follows:**

(1) To determine the physicochemical properties, such as pH, total soluble solids, sugars, L-ascorbic acid, and carotenoids, and 2172 texture parameters from images in color channels *R, G, B, S, U, V, X, Y, Z, L, a,* and *b* of yellow sweet bell pepper 'Yellow California' before lacto-fermentation and after 7, 14, 28, and 56 days of the process.

(2) To determine the linear correlations between physicochemical properties and image texture features.

(3) To set linear regression equations for estimating the changes in the physicochemical properties of yellow sweet bell pepper during lacto-fermentation based on image parameters.

## METHOD

**Spontaneous lacto-fermentation**: yellow pepper pieces, allspice, black pepper, bay leaves, mustard seeds, 3.5% brine.

**Lacto-fermentation periods**: 7, 14, 28, and 56 days.

**Image acquisition**: Epson Perfection flatbed scanner (Epson, Suwa, Nagano, Japan).

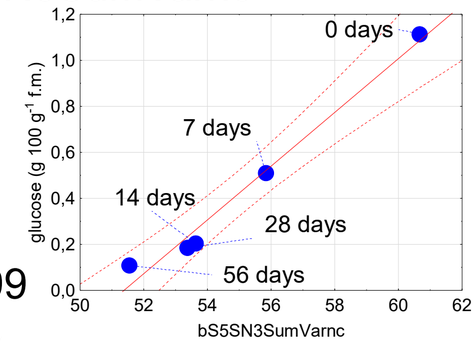
**Image processing**: MaZda 4.7 software (Łódź University of Technology, Institute of Electronics, Łódź, Poland) (Szczypiński et al., 2007; Szczypiński et al., 2009; Strzelecki et al., 2013).

**Physicochemical properties**:
pH – titrator (SI Analytics, TitroLine7000, Weilheim, Germany),
total soluble solids – refractometer RE50 (Mettler Toledo, Greifensee, Switzerland),
sugar content – HPLC (high-performance liquid chromatography) (Agilent Technologies, Morges, Switzerland),
L-ascorbic acid content – HPLC (Agilent Technologies, Morges, Switzerland),
carotenoid content – HPLC (Agilent Technologies, Morges, Switzerland).

**Correlation and regression**: STATISTICA 13.3 (StatSoft Polska Sp. z o.o., Kraków, Poland; TIBCO Software Inc., Palo Alto, CA, USA).

## RESULTS & DISCUSSION

**The highest correlation coefficients (R) were as follows**:
0.99: glucose and image texture bS5SN3SumVarnc
pH and VS5SV1Correlat
-0.99: fructose and RHPerc99
total sugars and RHPerc99
L-ascorbic acid and RHPerc99
total soluble solids and RHPerc99
0.98: ß-carotene and US5SH1Entropy
-0.98: ß-carotene and aHMaxm10




**Regression equations**: allowed for predicting physicochemical parameters based on image textures with high coefficients of determination ($R^2$) of up to 0.98.
glucose = -6.004 + 0.11685 * bS5SN3SumVarnc ($R^2$ = 0.98)
pH = -93.48 + 102.60 * VS5SV1Correlat ($R^2$ = 0.98)
fructose = 70.470 – 0.2742 * RHPerc99 ($R^2$ = 0.98)
total sugars = 131.11 – 0.5112 * RHPerc99 ($R^2$ = 0.98)
L-ascorbic acid = 5536.5 – 21.43 * RHPerc99 ($R^2$ = 0.98)
total soluble solids = 171.23 – 0.6492 * RHPerc99 ($R^2$ = 0.98)
ß-carotene = -1.287 + 0.86230 * US5SH1Entropy ($R^2$ = 0.97)
ß-carotene = 5.4799 – 5.460 * aHMaxm10 ($R^2$ = 0.97)

## CONCLUSION

The strong correlations (R of up to 0.99 and -0.99) and high coefficients of determination ($R^2$ of up to 0.98) confirm that image texture analysis can be a powerful, non-destructive tool for predicting key quality attributes of lacto-fermented sweet bell peppers.

## FUTURE WORK / REFERENCES

Future research can explore the relationships between image texture parameters and the physicochemical quality of various fruit and vegetable species during lacto-fermentation and other preservation methods.

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