A NOVEL APPROACH FOR DETERMINING COCONUT DRINK ADULTERATION BY MEANS OF LASER-LIGHT BACKSCATTERING IMAGING

Mac Xuan Hoa*, Ha Thi Thanh Nga, Nguyen Le Phuong Lien and Baranyai László
Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Hungary
*E-mail: xuanhoamac@gmail.com

1. INTRODUCTION

Coconut drink is known for not only its nutritional value but also as an isotonic drink thanks to its excellent rehydration index and blood glucose response.

Fruit based drinks have become one of the most 25 targets of food fraud and mislabelling, causing human health hazards and economic losses.

Laser light backscattering imaging (LLBI) is a novel and rapid method for quality evaluation of food.

The key objective of this work was to investigate applicability of laser light backscattering imaging technique to determine adulteration of coconut drink.

2. MATERIALS AND METHODS

2.1. Materials

Coconut drink was purchased in retail (SPAR Hungary Ltd., Bicske, Hungary).

2.2. Simulation of juice adulteration

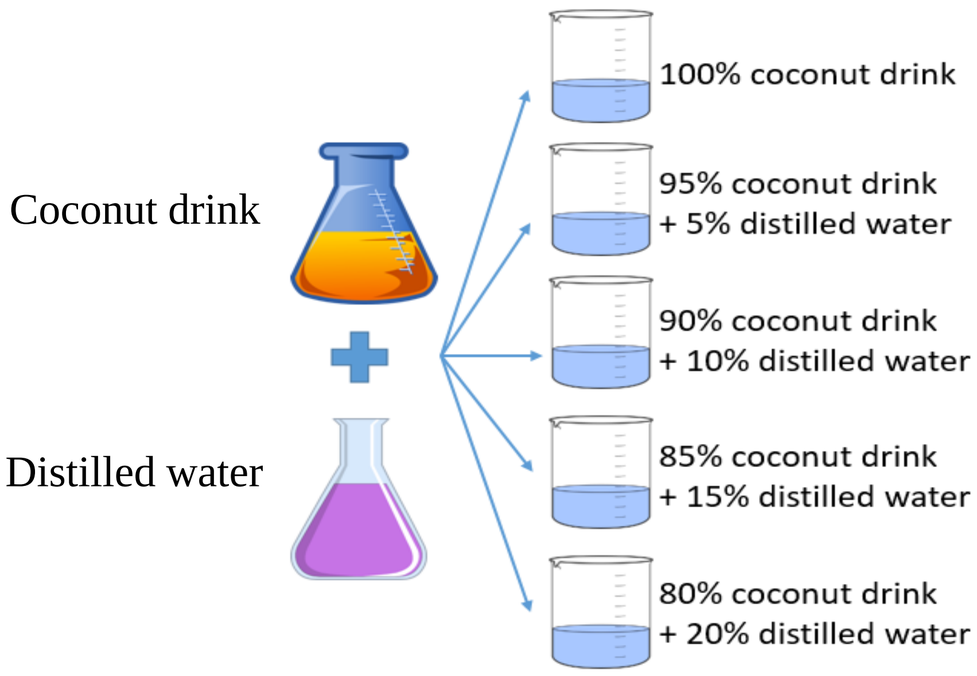

Figure 1. Procedure of adulteration

2.2. Data acquisition

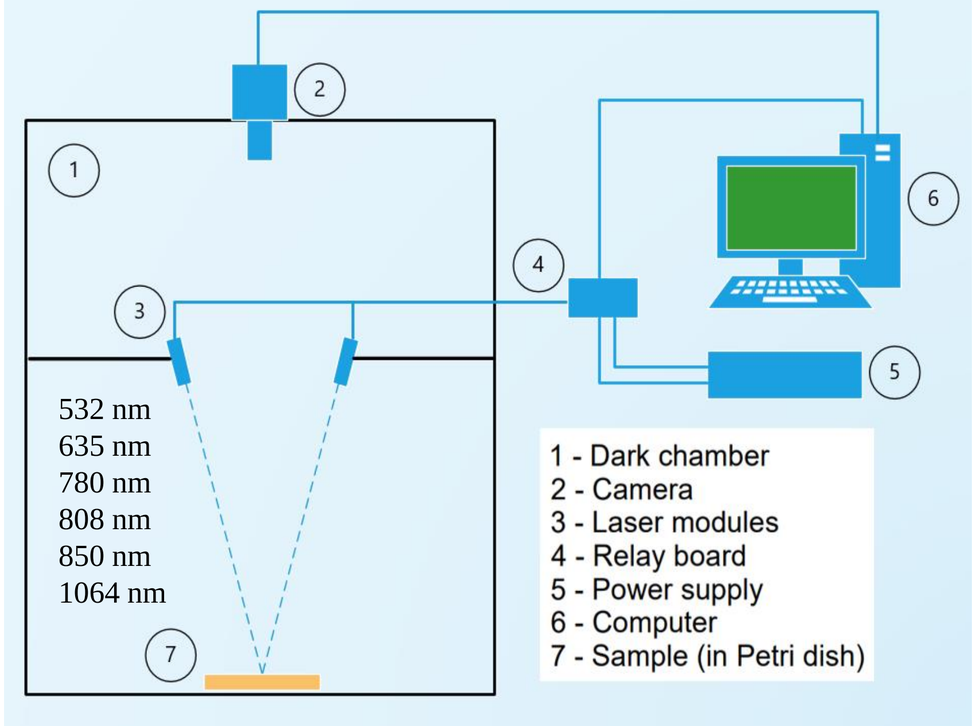

Figure 2. Setup of the laser vision system

2.3. Data analysis

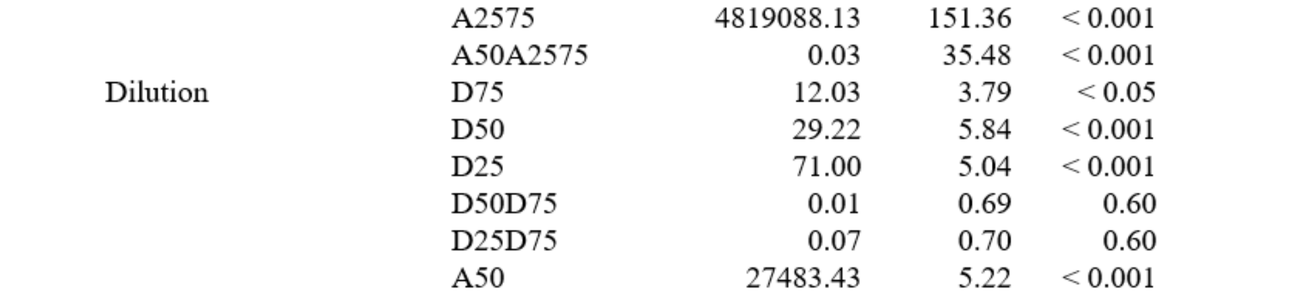

Figure 3. Procedure of data analysis

3. RESULTS

3.1. Change of laser backscattering parameters

Table 1. ANOVA result reflecting effects of factors on LLB parameters

Factor	LLB parameter	Mean Square	F	P
Wavelength	D75	319.65	100.61	< 0.001
	D50	691.59	138.13	< 0.001
	D25	2606.53	184.99	< 0.001
	D50D75	0.06	2.86	< 0.05
	D25D75	0.95	9.74	< 0.001
	A50	625015.05	118.63	< 0.001
	A2575	4819088.13	151.36	< 0.001
	A50A2575	0.03	35.48	< 0.001
Dilution	D75	12.03	3.79	< 0.05
	D50	29.22	5.84	< 0.001
	D25	71.00	5.04	< 0.001
	D50D75	0.01	0.69	0.60
	D25D75	0.07	0.70	0.60
	A50	27483.43	5.22	< 0.001
	A2575	201112.93	6.32	< 0.001
	A50A2575	0.00	0.54	0.71
Wavelength * dilution	D75	2.92	0.92	0.57
	D50	4.95	0.99	0.49
	D25	9.17	0.65	0.85
	D50D75	0.01	0.58	0.91
	D25D75	0.07	0.67	0.84
	A50	5130.78	0.97	0.51
	A2575	31400.86	0.99	0.49
	A50A2575	0.00	1.94	< 0.05

Dilution level significantly affected parameters related to light penetration depth ($p < 0.05$); meanwhile parameters describing signal shape were not significantly influenced. Results also highlighted the importance of the selection of measurement wavelength. On the other hand, no significant interaction effects were observed except for A50/A2575.

3.2. Classification and prediction

Table 2. Performance of LDA classification and PLSR prediction

Wavelength	LDA correct classification (%)	Performance of PLSR prediction		
		LV	R^2	RMSE
532 nm	92.3	2	0.576	4.58
635 nm	100	2	0.902	2.20
708 nm	100	2	0.922	1.96
808 nm	100	2	0.854	2.68
850 nm	100	2	0.837	2.84
1064 nm	100	2	0.889	2.33
All wavelengths	100	3	0.957	1.46

- LLBI combined with LDA models was able to correctly distinguish adulterated samples at success rate > 92%.
- All PLSR models had good performances with R^2>0.83 and RMSE<4.6, except for the one at 532 nm (R^2=0.576).

4. CONCLUSIONS

LLBI could accurately discriminate and quantify coconut dinks with 5% adulteration. The applicability of the non-destructive laser light backscattering imaging (LLBI) technique on assessment of adulteration of coconut drink was confirmed.