

## Differentiation between pure honey and honey adulterated with sugar syrups based on physicochemical investigations

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### Background

- ❖ Honey is a supersaturated solution of sugars with fructose and glucose as main saccharides.
- ❖ The quality of honey is defined by physico-chemical composition criteria and specific organoleptic and colour characteristics which can be influenced by different adulteration practices.

### AIM

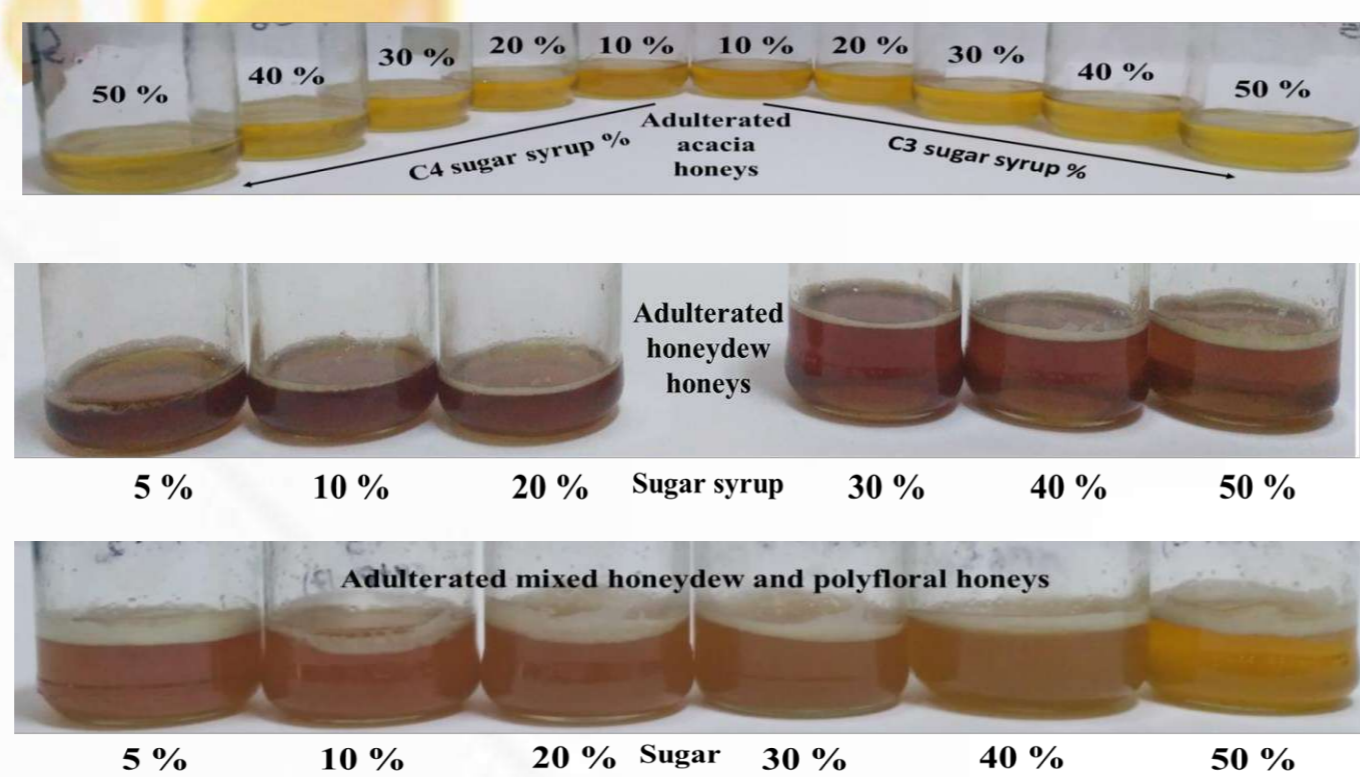
- ❖ The aim of the present study was to discriminate between pure and adulterated honey produced by direct incorporation of different percentes of commercial sugar syrups (5, 10, 20, 30, 40 and 50%) in honey using basic physicochemical parameters (moisture, pH, electrical conductivity) and specific sugars (fructose, glucose, sucrose and maltose).

### EXPERIMENTAL



Direct adulteration of honey with sugar syrups

### Adulterated honey samples



- ❖ Seventy-seven adulterated honey samples derived from pure acacia, rape, linden, sunflower, polyfloral and honeydew honeys and five commercial sugar syrups were investigated

### Methods

- ❖ physicochemical investigations - methods proposed by International Honey Commission
- ❖ HPLC-ELSD - sugar analysis
- ❖ Chemometric tools (LDA- Linear Discriminant Analysis) was used for statistic evaluation of the data

### Results and discussions

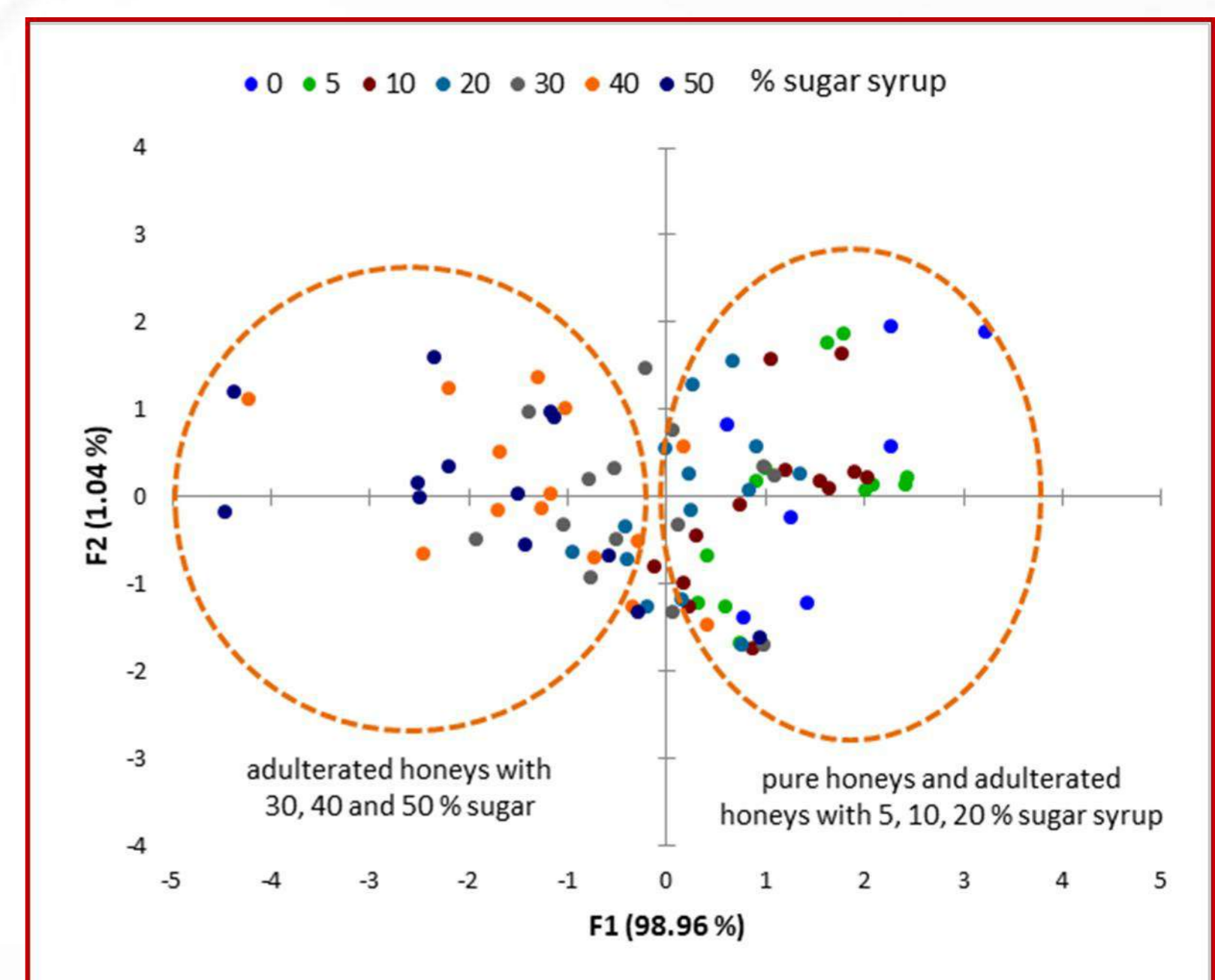
#### Physicochemical characterization and sugar content of pure and adulterated honeys

			Refractive	Water	°BRI	pH	Conductivit	Fructose	Glucose	Sucros	Maltos	F+G	Sugars	
			index	content (%)	X									y (µS/cm)
sunflower	pure	Average	1.4909	18.2	80.08	3.966	239.5	32.2	34.1	1.1	2.8	0.95	66.3	70.3
		Min	1.4898	17.7	79.65	3.938	171.6	27.0	29.9	0.1	1.5	0.86	58.3	64.4
		Max	1.4922	18.7	80.57	4.017	290.9	35.4	37.6	3.8	5.5	1.05	72.2	74.7
	adulterate d	Average	1.4943	16.9	81.37	3.850	314.79	40.34	33.96	0.19	1.36	1.31	40.53	75.85
		Min	1.4849	14.6	77.76	3.567	231.40	37.61	17.21	0.00	0.80	0.93	37.75	71.22
		Max	1.5004	20.6	83.67	4.056	380.50	52.85	40.56	0.44	2.28	3.07	53.01	79.77
honeydew	pure	Average	1.4957	16.4	81.90	4.457	519.0	32.30	26.10	0.19	4.22	1.24	58.4	62.8
		Min	1.4949	16.1	81.60	4.420	366.0	25.89	24.00	0.05	2.00	1.00	50.1	55.4
		Max	1.4963	16.7	82.13	4.485	655.4	38.00	27.70	0.33	8.00	1.37	65.7	68.0
	adulterate d	Average	1.4972	15.8	82.45	4.437	812.13	35.22	27.17	0.16	2.74	1.30	35.38	65.29
		Min	1.4945	14.8	81.45	4.140	677.90	30.59	24.38	0.00	0.76	1.22	30.97	60.02
		Max	1.4995	16.8	83.33	4.952	1177.70	38.64	29.83	0.38	4.67	1.43	38.91	69.49
linden	pure	Average	1.4922	17.7	80.56	4.118	320.1	29.66	30.71	0.13	4.67	0.88	55.3	59.7
		Min	1.4915	17.5	80.30	4.018	228.1	24.60	26.93	0.07	2.60	0.00	0.0	0.0
		Max	1.4928	18.0	80.80	4.199	396.5	35.63	33.02	0.19	8.03	1.08	68.5	71.7
	adulterate d	Average	1.4966	16.0	82.24	4.322	523.85	36.97	29.76	0.03	3.04	1.28	37.00	69.80
		Min	1.4927	14.4	80.76	4.017	423.10	33.40	23.83	0.00	1.97	1.02	33.40	68.19
		Max	1.5007	17.6	83.78	4.927	725.30	42.04	32.83	0.12	3.75	1.76	42.16	71.57
polyfloral	pure	Average	1.4938	17.1	81.17	3.766	261.2	40.00	31.77	0.71	4.61	1.26	71.8	77.1
		Min	1.4923	16.5	80.61	3.706	193.1	33.90	28.20	0.50	1.90	1.07	62.6	67.6
		Max	1.4953	17.7	81.75	3.833	321.7	44.80	33.60	0.90	10.00	1.35	78.2	81.8
	adulterate d	Average	1.4954	15.4	82.79	3.969	424.48	38.53	32.79	0.26	2.64	1.18	38.79	74.22
		Min	1.4760	14.4	81.41	3.634	237.20	35.45	28.42	0.00	1.81	1.08	35.58	66.58
		Max	1.5008	16.8	83.82	4.420	692.30	40.77	37.71	0.95	3.82	1.30	40.96	81.06
rape	pure	Average	1.4932	17.4	80.96	3.960	104.7	34.62	38.31	0.21	2.18	0.91	72.9	75.3
		Min	1.4875	14.6	78.77	3.864	57.7	30.82	30.66	0.10	0.53	0.86	63.2	66.5
		Max	1.5004	19.6	83.67	4.197	137.0	36.69	42.26	0.40	6.93	1.06	78.8	80.0
	adulterate d	Average	1.4935	17.1	81.24	3.988	185.04	37.48	40.09	0.10	1.28	0.94	37.58	78.95
		Min	1.4845	13.0	78.26	3.770	137.40	33.74	35.52	0.00	0.74	0.80	33.74	71.66
		Max	1.5087	20.2	86.74	4.229	395.20	54.36	52.83	0.54	2.87	1.11	54.57	110.27
acacia	pure	Average	1.4941	17.0	81.30	4.263	164.7	37.91	27.73	0.19	6.44	1.40	65.6	72.3
		Min	1.4925	16.2	80.68	4.201	119.4	31.79	23.95	0.06	4.78	1.06	59.7	66.5
		Max	1.4960	17.6	82.01	4.329	203.1	50.86	47.70	0.40	9.73	1.65	98.6	108.4
	adulterate d	Average	1.4933	17.2	81.08	4.118	154.16	42.33	27.10	1.02	2.04	1.60	43.35	72.50
		Min	1.4807	14.4	76.12	3.725	91.10	31.70	15.74	0.00	0.27	1.11	33.01	55.19
		Max	1.5007	22.7	83.78	4.469	235.70	45.71	36.07	5.12	4.76	2.79	46.60	78.13
sugar syrups	Average	1.4729	22.0	74.56	4.559	42.9	24.79	25.47	3.29	10.03	0.98	50.3	63.6	
	Min	1.4548	15.4	65.56	3.975	18.9	17.47	23.00	0.00	0.15	0.68	42.2	59.4	
	Max	1.4833	25	82.80	4.9673	74.8	30.69	32.00	15.81	20.96	1.32	62.6	68.7	

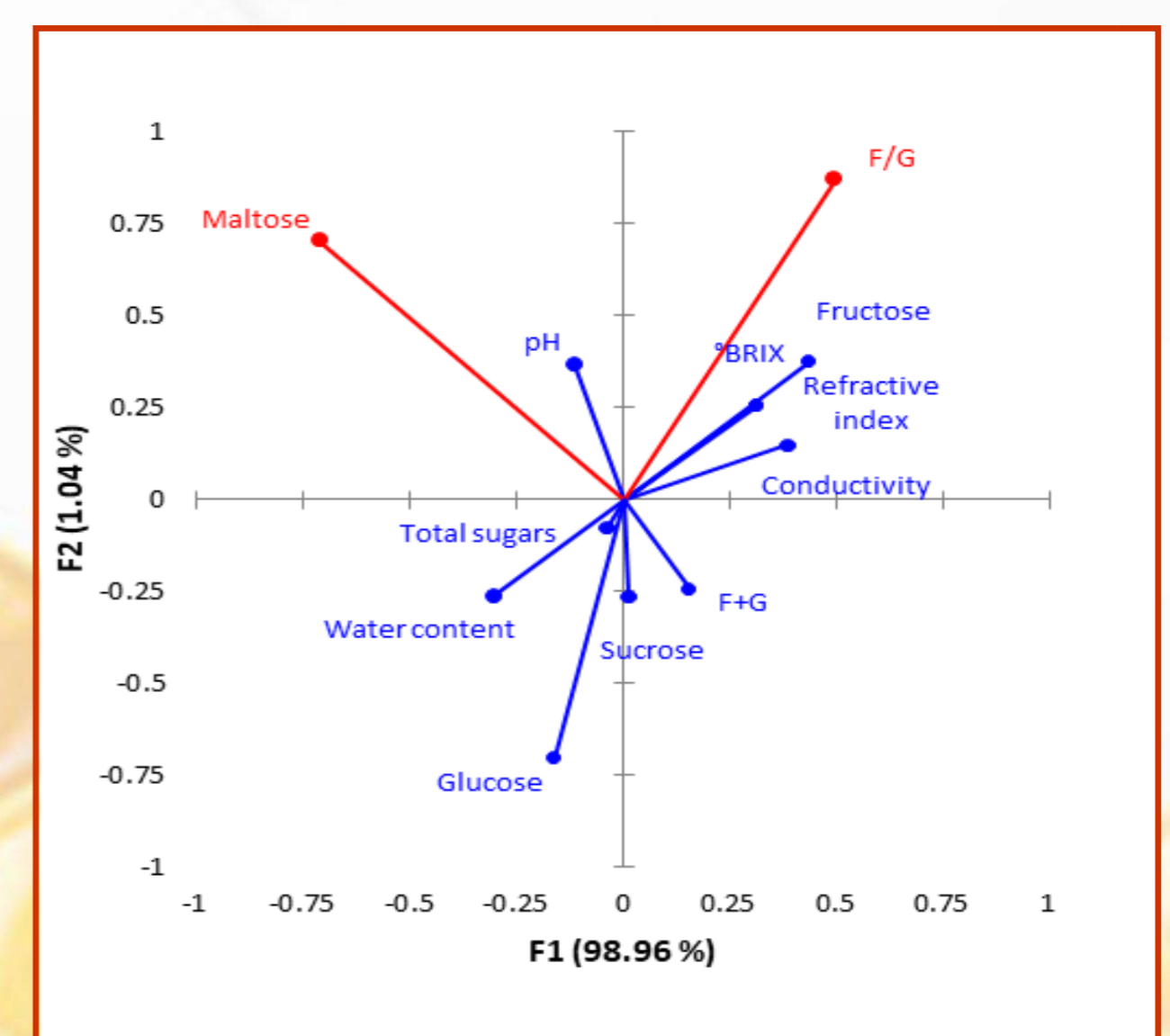
- ❖ Direct incorporation of sugar syrups in honey led to the change of honey physico-chemical parametres, but within the range of variation for pure honeys, which makes that the single use of basic physico-chemical parameters to be inappropriate for a correct authenticity decision.
- ❖ Conductivity can be considered as potential marker for discrimination of adulterated honeys, especially for honeydew honey.
- ❖ LDA analysis allows the discrimination of adulterated honeys starting from 30-40% sugar syrup addition in honey, maltose, glucose, total sugars, pH and water content can be considered as possible markers.

### Conclusion

- ❖ Combination with other representative parameters such isotopic fingerprint, elemental composition or bioactive composition would be more suggestive.
- ❖ In order to establish robust methodologies enable to evaluate the authenticity of suspicious honeys, it is essential to create complex databases with authentic honey samples, more specifically for each type of honey.



Scatter plot of the first two LDA discriminant functions showing separation between honey samples



Correlation between the analysed parameters and the factors in discriminant analysis of honey samples

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