

# Correlation Analysis of Mineral Element Content and Sensory Quality of National Geographical Sign Product--Olecranon Peaches in Lianping

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**Abstract.** Microwave digestion-inductively coupled plasma astigmatism (ICP-AES) was used to analyze the contents of mineral elements (including K, P, Mg, Ca, Na, Fe, Cu, Mn, B, Zn, Se, Li) in 54 Olecranon Peaches collected from Shangping town, Lianping County. The obtained data was analyzed by Correlation analysis (CA), combined with fruit reducing sugar (RS%), sugar-acid ratio (S/A) and sensory scores. The results showed that in the tested samples, it had a significant positive correlation between S/A sugar-acid ratio and sensory evaluation. S/A was negatively correlated with P contents. The P contents were positively correlated with the K, Mg contents. The Mg contents were positively correlated with the K, Na contents. The Na contents were positively correlated with the Mn contents. The contents of Mn were positively correlated with RS% ratios of reducing sugar.

## 1 Introduction

Lianping Olecranon Peach, a hard meat peach species, named for the shape of an Eagle's beak, mainly was produced in Shangping Town, Lianping County, Heyuan City, Guangdong Province. Olecranon Peach is the best peach variety in Guangdong and even in the south of China. It is praised by agricultural experts as "the ultimate peach product".

Mineral elements are indispensable for fruit growth and development. Its kinds and contents are also one of the important indexes to measure its nutritional value. The traceability index of mineral elements in different foods are different. Lu Baoxin et.al[1] showed that analysis of mineral content data was useful for tracing the geographical origin of soybeans from different producing areas in the province. And six metal elements, Na, K, Mn, Rb, Ba and Au, were identified as indicators for traceability analysis. Borges et.al[2] sifted out that As, B, Ba, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, P, Rb and Zn 14 elements were selected to identify the differences between organic and common rice. Zhao et.al[3] screened out Na, Ca, Fe, Zn and Mo from wheat and soil samples from three different producing areas in China. Zheng Hui [4] analysed and sifted out five elements (Mg, Cg, Ng, Mn and Zn) with high local attribute of Liuhe County Rice. Zhang Yue et.al[5] achieved a small range of origin traceability, the trace elements of Zn, K, Mg, Na, Ca and Mn in Songyuan were obtained by using mineral elements. Mn, Fe, Co, Cu, Zn, Se, Rb, Sr, Ba, Pb,

Ca, Mg, Na were verified to determine the origin of milk powder by Dang et.al[6]. Zhao Qian [7] thought that Zn, Pb, Fe, Mg, Cu in Meihe Rice have good stability and space representativeness, which can be used as the confirmation index of rice producing area.

Organic component traceability is also one of the effective analysis methods to evaluate the quality of famous and special products and to distinguish the origin of food. The traceability model established by Wang Kaiqiang [8] using Gas Chromatography to detect fatty acids in pork was better than that established by nuclear magnetic resonance technique. And the accuracy was 100%. The correct discrimination rate of soybean monomers, such as Daidzin, Glycitin and Genistein, screened by Liu Wenjing [9] was 81.1%, which met the requirements of the discrimination analysis of soybean origin.

In 2015, permission was granted for Lianping Olecranon Peaches to be protected with a geographical sign product. Olecranon Peaches are not only planted in Lianping, but also Fujian Longyan, Wuping Yao Lu, Guangdong Wengyuan (Jiuxian peach). In addition, near the surrounding areas of Lianping there are planting olecranon peach, such as Liyuan Town Heping County, Tianxin Town Longchuan County. But Lianping Olecranon Peaches, especially Shangping are the most delicious as consumers reflected. For the protection of national geographical sign products and the need of construction of Olecranon Peach industry park in Lianping County, it has great significance to analyze the

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mineral element content and nutrient content of Lianping Olecranon Peache, and to establish a discriminant model combined with sensory evaluation.

## 2 Materials and methods

### 2.1 Materials and reagents

Olecranon Peaches: Obtained from Shangping Town, Lianping County

The standard solution concentration of 12 mineral elements (K, P, Mg, Ca, Na, Fe, Cu, Mn, B, Zn, Se, Li) is all 1 mg/mL: purchased from the General Institute of Iron and Steel Research of the National Iron and Steel Materials testing Center; Concentrated Nitric Acid (excellent grade pure): purchased from Shanghai Chinese Medicines Chemical Reagent Co., Ltd.; Ultrapure Water: laboratory self-made (conductivity 18.2 MΩ)

### 2.2 Instruments and equipments

7000DV inductively coupled plasma divergence spectrometer (PERKINELMER US); ETHOS One microwave digestion / extraction system (Beijing Lebertaic instrument Co., Ltd.); AL104 electronic balance (Mettler-Toledo, US).

### 2.3 Determination of mineral elements in Olecranon Peaches

#### 2.3.1 Fruit Pretreatment

The samples were peeled and nucleated after ultra-pure water washing and controlled dry water, evenly distributed, and divided into two parts. A part was placed in a fresh-keeping bag-80°C frozen and stored, and the other part was used for sensory evaluation and nutritional determination.

#### 2.3.2 Microwave digestion and analysis of samples

The 0.5000 g sample was taken and placed in the polytetrafluoroethylene(PTFE) microwave digestion tank, with 6 mL of concentrated nitric acid, the inner cover was covered and the coat was tightened, and the microwave digestion system was put in. The digestion conditions were shown in table 1. After digestion, cooled to 60-70°C temperature in the tank, removed the digestion tank from the ventilation cabinet to remove acid, transferred the solution to 10 mL capacity bottle, fixed the volume with ultra-pure water, mixed well and set aside. A 7000 DV ICP-AES was used to determine the content of 12 mineral elements in the samples.

**Table 1** Microwave digestion conditions

Steps	t/min	θ/°C	p/MPa	P/W
1	5	100	1.0	800
2	8	120	1.5	800
3	5	140	2.0	800

### 2.4 Determination of Nutrient Components of Olecranon Peaches

Direct titration was used for the determination of reducing sugar(RS) according to GB 5009.7-2016. GB 5009.8-2016 was used for determination of total soluble sugar (S)with acid hydrolysis titration. GB 5009.239-2016 was used for determination of titratable acid (A) with NaOH titration. Reduction sugar ratio (RS%)= reducing sugar content / soluble total sugar content 100; sugar-acid ratio (S/A)= soluble total sugar content / titratable acid content.

### 2.5 Sensory evaluation of Olecranon Peaches

Nine peach evaluators were invited to conduct training, and then the color, taste and aroma of the Olecranon Peaches were evaluated. The scoring table is shown in table 2.

**Table 2** Grades of Sensory Quality of Olecranon Peaches

Item score	Colour (20%)	Palate (40%)	Aroma (40%)
100	The coloring is very even, the surface is very smooth	The flesh is very delicate, juicy and taste good	Fruity is strong
80	The coloring is even, the surface is smooth	Delicate, juicy, good taste	Fruit rich
60	The coloring is less even. It's got a smooth surface	The pulp is more delicate, juicy and taste better	Strong fruit aroma
40	The coloring is uneven and the surface is less smooth	Rough pulp, less juice, less taste	Fruity is light
20	The coloring is uneven and the surface is not smooth	Rough pulp, less juice, poor taste	Light fruit
0	The color is very uneven. The surface is extremely unpolished	The pulp is very rough, very little juice, very poor taste	Fruity is light
Score Total			

### 2.6 Data analyses

The correlation analysis (CA) was carried out by SPSS 23.0 software to find out the mineral elements and nutrient components significantly related to the sensory evaluation of Olecranon Peaches.

## 3 Results and Analyses

### 3.1 Trace element content of Olecranon Peaches

According to 1.3 method, the mineral elements content of Olecranon Peaches were determined. The results were shown in Fig.1-12. (FW means fresh fruit weight. )

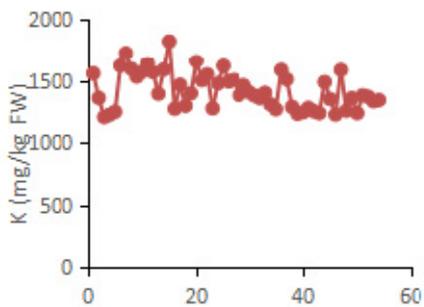


Fig.1 Contents of K in 54 samples

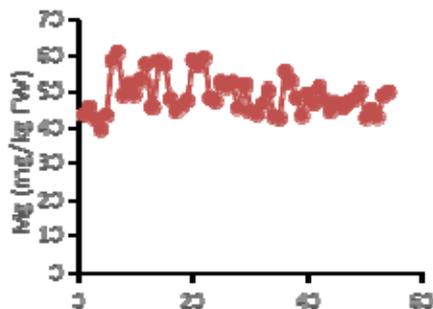


Fig.2 Contents of Mg in 54 samples

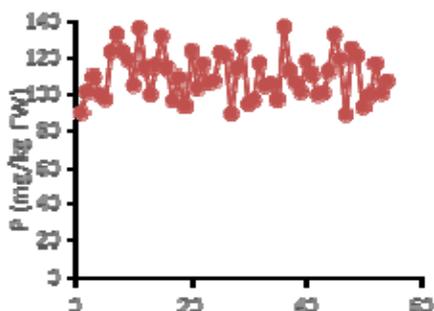


Fig.3 Contents of P in 54 samples

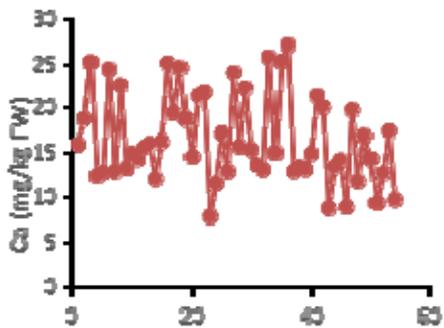


Fig.4 Contents of Ca in 54 samples

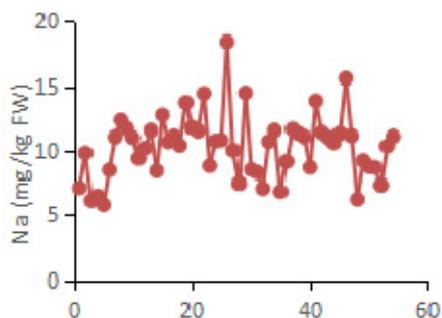


Fig.5 Contents of Na in 54 samples

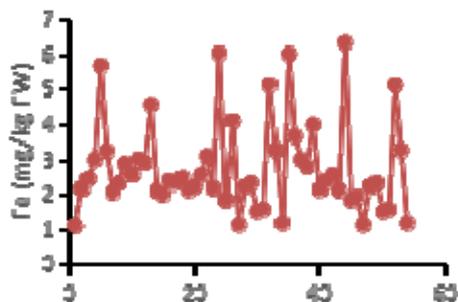


Fig.6 Contents of Fe in 54 samples

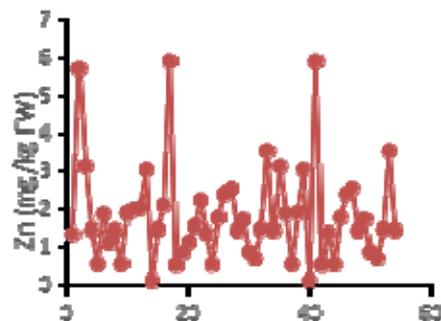


Fig.7 Contents of Zn in 54 samples

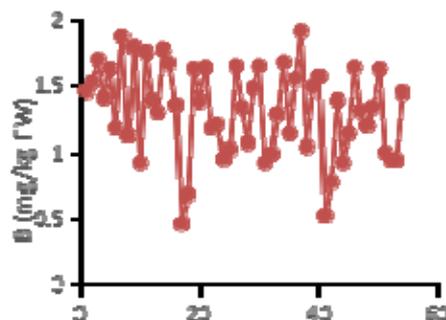


Fig.8 Contents of B in 54 samples

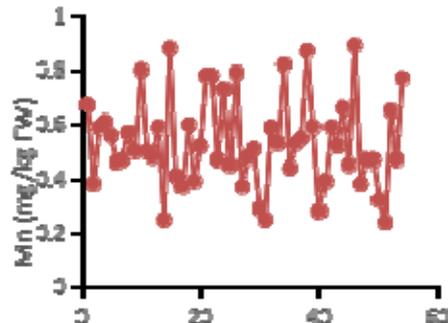


Fig.9 Contents of Mn in 54 samples

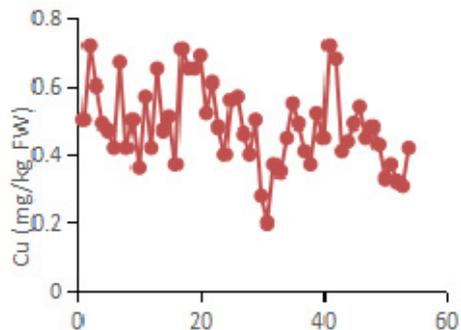


Fig.10 Contents of Cu in 54 samples

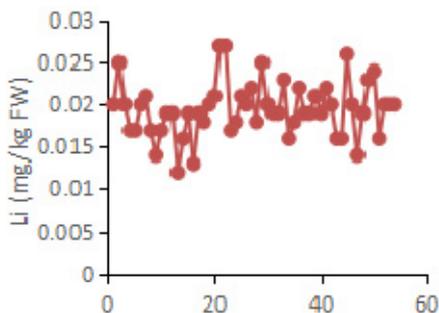


Fig.11 Contents of Li in 54 samples

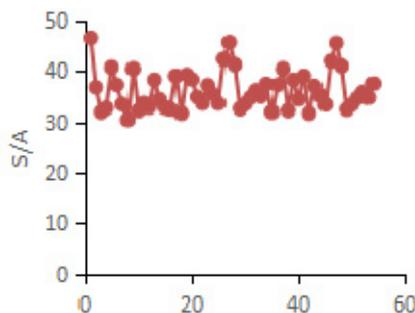


Fig.14 Contents of S/A in 54 samples

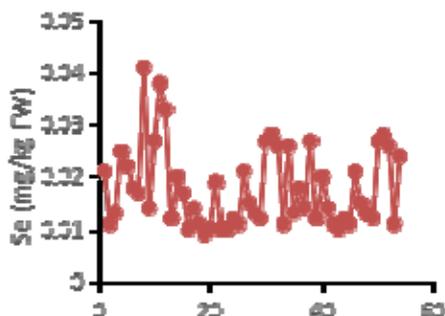


Fig.12 Contents of Se in 54 samples

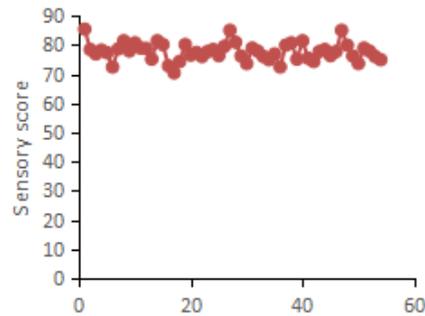


Fig.15 Sensory evaluation scores of 54 samples

Fig.1-12 showed that, in the 54 samples tested, The K contents were between 1205-1820 mg/kg. The Mg contents were between 39.29-60.65 mg/kg. The P contents were between 89.4-136.6 mg/kg. The Ca contents were between 7.75-26.99 mg/kg. The Na contents were between 5.80-18.43 mg/kg. The Fe contents were between 1.08-6.32 mg/kg. The Zn contents were between 0.10-5.89 mg/kg. The B contents were between 88.51-136.6 mg/kg. The Mn contents were between 0.24-0.89 mg/kg. The Cu contents were between 0.20-0.72 mg/kg. The Li contents were between 0.012-0.027 mg/kg. The Se content were between 0.001-0.041 mg/kg.

### 3.2 Nutrient Content and Sensory Evaluation Score of Olecranon Peaches

According to 1.4 and 1.5 methods, the nutritional contents and sensory evaluation of the fruit were determined. The results were shown in Fig.13-15.

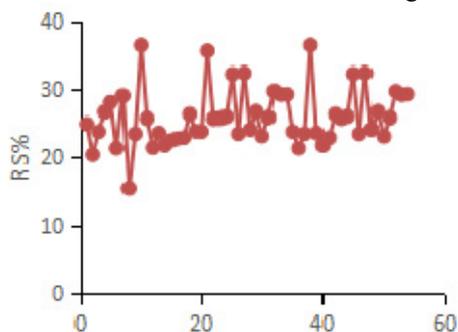


Fig.13 Contents of RS% in 54 samples

From the Fig.13-15, we can see that the ratios of reducing sugar (RS%) were 15.47%-36.43%. The ratios of sugar to acid were 30.46-46.61. And the scores of sensory evaluation were 70.4-85.4.

### 3.3 Correlation analyses

The composition of mineral elements, RS%, S/A and sensory evaluation of 54 samples were divided into independent variables. Using SPSS 23.0 software, pearson correlation was used to establish the correlation analysis between mineral elements, RS%, S/A and sensory evaluation score. The results were shown in table 3.

Table 3 showed that, K contents and P, Mg contents were significantly positively correlated. The P contents were positively correlated with the K, Mg contents and negatively correlated with the S/A contents. The Mg contents were positively correlated with the K, P, Na contents. And it had a significant positive correlation with B, Li contents. The Ca contents were positively correlated with the Zn contents. And it had a significant positive correlation with Li contents. The Na contents were positively correlated with the Mg, Mn contents. And it had a significant positive correlation with Cu contents. The Zn contents were positively correlated with the Ca, Cu contents. And it had a significant negative correlation with B contents. The B contents were positively correlated with the Mg contents. And it had a significant negative correlation with Zn contents. The Mn contents were positively correlated with the Na contents. And it had a significant positive correlation with RS% ratios. The Li contents were positively correlated with the Mg, Ca contents. The Cu contents were positively correlated with the Zn contents. And it had a significant positive correlation with Na contents,

also had a significant negative correlation with Se contents. The Se contents and the Cu contents were significantly negative correlation. And there were significant positive correlation between reducing sugar contents and Mn contents. A significant negative

correlation was existed between sugar-acid ratios and P contents, it was positively correlated with the senses.

### 4 Conclusions

**Table 3** Correlation between mineral element content and nutrient content and sensory evaluation of Olecranon Peaches

Serial number	Correlation	Serial number	K	P	Mg	Ca	Na	Fe	Zn	B	Mn	Li	Cu	Se	RS%	S/A	Senses
		1	-.394**	-.063	-.209	-.232	.089	-.024	-.056	-.247	-.057	.133	-.352**	-.099	.235	.052	-.112
K	Correlation	-.394**	1	.416**	.713**	.125	.252	-.083	-.108	.184	.080	.058	.107	.148	-.021	.049	.258
P	Correlation	-.063	.416**	1	.553**	-.002	.205	.079	-.139	.182	.182	.185	.141	.060	-.175	-.273*	-.126
Mg	Correlation	-.209	.713**	.553**	1	.158	.354**	-.143	-.145	.268*	.069	.274*	.195	-.076	-.012	-.098	.044
Ca	Correlation	-.232	.125	-.002	.158	1	.038	.003	.380**	-.159	-.121	.268*	.235	-.237	-.107	-.175	-.240
Na	Correlation	.089	.252	.205	.354**	.038	1	-.126	.188	.055	.373**	.189	.335*	-.162	-.009	.088	-.058
Fe	Correlation	-.024	-.083	.079	-.143	.003	-.126	1	-.002	-.183	.246	-.159	-.020	-.085	-.041	-.110	-.162
Zn	Correlation	-.056	-.108	-.139	-.145	.380**	.188	-.002	1	-.288*	-.044	.239	.392**	-.215	-.065	.142	-.241
B	Correlation	-.247	.184	.182	.268*	-.159	.055	-.183	-.288*	1	.062	.052	.005	.123	-.177	.155	.199
Mn	Correlation	-.057	.080	.182	.069	-.121	.373**	.246	-.044	.062	1	.050	.079	.082	.302*	-.001	.034
Li	Correlation	.133	.058	.185	.274*	.268*	.189	-.159	.239	.052	.050	1	.182	-.142	.153	-.129	-.169
Cu	Correlation	-.352**	.107	.141	.195	.235	.335*	-.020	.392**	.005	.079	.182	1	-.410**	-.205	.113	-.150
Se	Correlation	-.099	.148	.060	-.076	-.237	-.162	-.085	-.215	.123	.082	-.142	-.410**	1	-.031	-.186	.210
RS%	Correlation	.235	-.021	-.175	-.012	-.107	-.009	-.041	-.065	-.177	.302*	.153	-.205	-.031	1	-.005	.174
S/A	Correlation	.052	.049	-.273*	-.098	-.175	.088	-.110	.142	.155	-.001	-.129	.113	-.186	-.005	1	.368**
Senses	Correlation	-.112	.258	-.126	.044	-.240	-.058	-.162	-.241	.199	.034	-.169	-.150	.210	.174	.368**	1

\*\* . at level 0.01(double tail), the correlation was significant ;\*. At 0.05 level (double tail), the correlation was significant.

In this paper, the contents of mineral elements (including K, P, Mg, Ca, Na, Fe, Cu, Mn, B, Zn, Se, Li) in 54 Olecranon Peaches were collected. Reducing sugar(RS), total soluble sugar (S) and titratable acid (A) were determined by the National Standard. The correlation analysis (CA) was carried out by SPSS 23.0 software to find out the mineral elements and nutrient components significantly related to the sensory evaluation of Olecranon Peaches. The results showed that in the tested samples, it had a significant positive correlation between S/A sugar-acid ratio and sensory evaluation. S/A was negatively correlated with P contents. The P contents were positively correlated with the K、Mg contents. The Mg contents were positively correlated with the K、Na contents. The Na contents were positively correlated with the Mn contents. The contents of Mn were positively correlated with RS% ratios of reducing sugar.

Systematic studies on the relationship between mineral elements, nutritional components and sensory evaluation of Olecranon Peaches were few. This paper is just a simple preliminary study. Further research is needed to collect relevant data for different years in order to establish a complete and reliable correlation model.

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