

李正积 傅平都 庞在祥

涪陵榨菜

优质的原因



四川科学技术出版社

涪陵榨菜优质的原因

榨菜品质与农业地质背景关系的研究

李正积 傅平都 庞在祥 著

(国家自然科学基金资助项目)

四川科学技术出版社

1989年·成都

**THE REASON FOR GOOD QUALITY
OF UNIQUE FULING ZHACAI**

Li Zhengji Fu Pingdu Pang Zaixiang

**The Project Supported by National Natural Science
Foundation of China**

**Sichuan Publishing House of Science and Technology
1989 Chengdu China**

责任编辑：黄光骞

封面设计：李清拂

技术设计：康永光

责任校对：吴澄波

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四川科学技术出版社出版发行

(成都盐道街三号)

新华书店重庆发行所经销

重庆印制一厂印刷

统一书号：ISBN 7-5364-1204-5/S·174

1989年7月第一版 开本787×1092毫米1/32

1989年7月第一次印刷 字数 100 千

印数1—8800册 印张 5.25 插页 2

定 价： 2.45 元

前 言

随着涪陵榨菜成为佐餐佳品，越来越受到人们的喜爱，榨菜业在国民经济中的地位也迅速提高，各榨菜产区也都成为乡镇企业和个体经营者的主要经济来源。

目前榨菜菜头的发展亦出现了欣欣向荣的形势，但其优势产区何在，优质高产信息该怎样去捕获，菜头发展的合理布局又如何考虑呢？等等。由于现代科学技术的不断发展，地学与农学交叉结合而孕育的边缘学科领域，即农业地质背景研究，在对很多作物的优质高产效应方面，都反映出较高的应用价值。通过菜头的产量品质与地质背景的相关性研究，初步揭示出菜头种植区的两个动态平衡问题：

第一：土壤母岩→土壤→菜头的地球化学元素的迁移聚积平衡系统；

第二，大气降水→岩石土壤水→菜头的生理水分供需平衡系统。

这样就会获得具有优良品质的菜头分布区域的客观变化，或者说能发现农业上确定的优质高产三种条件（良种、良法和良境）和优势生态环境区的综合特征。同时也逐渐使人们认识到因地制宜（地质背景及土壤条件）配置菜头良

注：本项目属国家自然科学基金资助项目，主要参加的有李正积、傅平都、庞在祥；杨丽华参加部分室内工作，蒋邦华协助一定野外工作，何裕文、殷尚国作了部分协助工作。

种、科学施肥及科学管理是何等的重要。

从科学管理角度讲,如果由于生产需要,必须在次要适宜区种植菜头,就应充分研究环境本底(农业地质背景为其主要基础)。搞清两个动态平衡的物质、能量循环关系,捕获可靠的补偿信息,达到有目的地进行菜头种植区的土壤改良;根据最佳环境条件模拟优势小生境区营养元素组合类型,补施适中的有效含量。若能如此,就会省钱、省时和省工,以达到合理的菜头发展布局和取得良好的产投比例。这也说明采用农业地质背景方法,对研究我国独具特色的名咸菜—涪陵榨菜的优质型商品具有较高的经济效益和深远的实际意义。

本专著的完成,还得到课题顾问侯光炯教授、路兆洽研究员的热情指导;何万海工程师、周正中工程师等协助测试岩石、土壤和菜头样品;并幸得侯光炯教授、刘宝珺教授、刘佩瑛教授、林冠伯教授和黄裕蜀高级农艺师为主的八位专家评审组,提供了许多宝贵意见。谨此表示谢意!

作 者

1988年4月

涪陵榨菜优质的原因

榨菜品质与地质背景关系的研究

摘要

四川涪陵榨菜，中外闻名。其产品营养丰富，含有氨基酸、维生素、蛋白质、糖类、脂肪等，并具有鲜、香、嫩、脆的独特风味。它是老幼皆宜，居家旅行的上乘佐餐佳品。然而，关于涪陵榨菜为何质优？迄今尚无从地质学角度未解释的资料。

榨菜的原料习称菜头，即蔬菜品种的茎用芥菜变种。近四年来，我们探索了菜头与地质背景（同大农业相关的岩石体与地质营力作用的综合，它包括岩石体、地球化学、水文地质和地貌等条件）的相关性，这属于边缘学科（新义农业地质）的一个新领域。该项获得的主要成果如下：

（一）榨菜菜头的地质背景为菜头生态环境的基础，并具有密切的相关性。在相同气候区里，地质背景能使菜头品种产生地域性选择，还成为一种普遍现象。对于农业地质背景的这一正确认识，已为分析四川大量的作物类型和各种各样的植物品种成果所证实。

（二）涪陵地区的岩石体（土壤母岩）主要由浅色砂岩和红色泥岩所组成，归属于侏罗系中、上统的上下沙溪庙组

和遂宁组岩层。其岩石体是菜头地质背景的主要组成之一。岩石暴露地表后，容易遭到分解和溶蚀，这是普通常识；因为岩石的风化可引起多种物质的复杂运移（如岩屑、各样矿物和多种元素物质）。我们利用涪陵一带的自然规律，已探索出具有特殊作用的自然整体平衡系统：

岩石体→土壤→菜头动态系

已经揭示出不同岩石体的地质背景特征对研究菜头生态系统具有重要的科学意义。

（三）菜头的多项地质背景中，元素的地球化学迁移是非常重要的条件。已经发现对菜头的生理营养元素，岩石具有不同的“天然供应库”作用。众多元素的每一种元素特征，如N、P、K、Ca、Mg、S和微量元素Zn、B等，它们在岩石风化、土壤发育过程中，都会长期地保留有自己的痕迹。通过元素对不同岩体→土壤→菜头平衡系统的形成影响，说明每种元素要明显地制约着菜头的生长。借助于各种元素分析（化学分析、吸收光谱、荧光光谱、X射线衍射等）取得了大量的科学信息，对我们研究涪陵榨菜的优质高产显示极大的应用价值。

1. 用元素分析和显微结构的观察，那进入菜头的不同元素离子变化显得非常清楚。

2. 涪陵地区不同土壤母岩的元素差异是明显的；这些对于植物的矿质营养元素的地球化学迁聚变化起着重要的作用。

3. 作为蔬菜作物菜头的相同品种，由于受着不同的农业地质背景所制约，因而它们吸收矿质元素的百分含量是极不相同的。例如涪陵地区上下沙溪庙组发育的土壤，菜头吸

收的磷量较遂宁组区多；而相同的菜头品种在上下沙溪庙组区吸收的钙量就较低。

4. 微量元素方面，上下沙溪庙组岩石发育的土壤具有较快的元素离子迁移率，但是其他岩组发育的土壤则是较慢的。这种因素会影响到菜头的品质。

5. 菜头吸收矿质元素时，它们常常会选择吸收某一些需要的元素。因此，对于菜头的元素生态效应能够直接影响其产量和品质。

(四) 水文地质条件对菜头生长来说，无论是微弱地下水的动态变化，或是水分渗入地下及浸润菜头的根系都是很重要的。近地表地下水的储集和运动条件，常常直接影响菜头的正常生长。我们研究证实，菜头含水量与毛细管水作用的关系非常密切。这样，它对实现大气降水→岩石土壤水→菜头生理水的供应平衡系统具有重要的作用。

(五) 该研究区位处川东“平行岭谷”地貌区，具有复杂的地貌条件。沿着长江上游涪陵一带考察的结果，发现大部分菜头种植区位于长江北岸；菜头的优势生态环境主要受到浅丘地貌所制约，那里通常呈现平缓的阳坡地貌的深厚土层，有利于菜头的优质高产。

(六) 涪陵地区优越的农业地质背景条件是发展榨菜优质高产的主要原因之一。很显然，对菜头生态环境的物质流和能量流来说，地质背景能够起着重要的基础作用。

菜头地质背景必须与气候因子、优良品种和施肥管理相结合，才能更好地发挥综合优势。

最后我们还借助于初步探索的农业地质背景成果，划分了涪陵榨菜的优势区和劣势区；同时作了发展远景区预测。

The Reason for Good Quality of Unique Fuling Zhacai

On the Relations between the Quality of Fuling
Zhacai and Geologic Background

Abstract

Well-known both in China and abroad, orthodox Fuling Zhacai from Fuling, Sichuan Province is the highly finished products full of nutrients, such as amino acid, vitamin, protein, sugar, fat, etc., and possesses a unique flavor, tastes fresh delicious and crisp. It is suitable both for old and young, family cooking and tourism. Then, what's the reason for good quality of Fuling Zhacai? Up to now people have found no answer to this question on the basis of the data on agricultural geology.

The raw materials of Fuling Zhacai are called prickled mustard tubers, i. e., the species *Brassica juncea* (L.) Czern. et Coss. var. *tumida* Ten et Lee. For four years, we have tried our best to study the relations between the quality of the mu-

stard tubers and geologic background (the synthesis of bedrocks and geological agents such as bedrocks, geochemical hydrogeological and geomorphic conditions, etc.) in the Fuling area, Sichuan Province. The study belongs to the new domain of a frontier science (new concept agricultural geology), resulting in the following main results:

Firstly, geologic background of the mustard tubers is closely related to its ecologic environments. In the background, various species of the mustard tubers in the same climatic regions may be selected regionally. A correct understanding on agricultural geologic background has been proved by the preliminary results on abundant crop types and plant varieties in Sichuan Province.

Secondly, bedrocks (mother rocks of the soil) in the Fuling area consist mainly of light-coloured sandstones and red claystones which belong to the Middle and Upper Jurassic Shaximiao and Suining Formations, and are regarded as one of the chief ingredients of geologic background. Since the weathering of the rocks may give rise to the removal of many kinds of material (e. g. rock fragments, various minerals and elements), when exposed on the earth's surface, the bedrocks are susceptible to disintegration and corrosion. With the help of na-

tural law in the Fuling area, the overall equilibrium system with particular action has been proposed as follows: bedrocks→soil→mustard tubers. It is revealed that the functions of geologic background of different bedrocks are of important scientific significance in studying ecologic system of the mustard tubers.

Thirdly, geochemical migration of the elements is also very important for geologic background for the growth of the mustard tubers. It can be seen that the rocks therein may serve as "natural supplying warehouse" for the nutritive and physiological chemical elements in the mustard tubers. Each of the elements (such as N, P, K, Ca, Mg, S and trace elements Zn, B) remains preserved for a long time during the weathering of the rocks and the development of the soil. In other words, the influence on the equilibrium system shows that the growth of the mustard tubers is evidently controlled by each of them. A large amount of scientific information has been acquired with the aid of various elemental analyses such as chemical analysis, absorption spectrometry, fluorescence spectrometry, X-ray diffraction analysis, and is of great value of application for us to study the reason for good quality and high output of the mu-

stard tubers growing in the Fuling area.

1. Ion variations of different elements into the mustard tubers is clearly observable on the basis of the analysis of the elements and micro-textures.

2. The distinct elements from different mother rocks of the soil in the Fuling area play an important part in geochemical migration and accumulation of nutritive mineral elements in the mustard tubers or other plants.

3. Since the same variety of the mustard tubers are controlled by different agricultural geologic background, percentage contents of mineral elements absorbed by the mustard tubers are not very much alike. For example, the mustard tubers growing in the soil of the Shaximiao Formation in the Fuling area tend to absorb more phosphorus than those in the soil of the Suining Formation, whereas calcium content absorbed by the same variety of the mustard tubers is relatively low in the Shaximiao Formation.

4. The ions of trace elements in the soil developed from the rocks of the Shaximiao Formation have faster migration rates, while those in the soil developed from other rocks have slower ones. This factor may exert an influence on the quality of

the mustard tubers.

5. When the mustard tubers absorb mineral elements from the soil, they tend to absorb selectively some of the elements available for them. Therefore, the output and the quality of the mustard tubers may immediately be influenced by the effect of the elements from the growing mustard tubers.

Fourthly, hydrogeologic conditions are very important to the mustard tubers whether faint changes in groundwater regime, or penetration into the ground and soaking the roots of the mustard tubers. The storage and removal of the groundwater near the surface may have an impact directly on the mustard tubers which are normally growing. Furthermore, the relations between water content in the mustard tubers and capillary action of underground material (rocks and the soil) have been verified by our studies in recent years. It follows that the conditions play an important part in attaining the equilibrium system: atmospheric water \rightarrow water in rocks and the soil \rightarrow physiologic water in the growing mustard tubers.

Fifthly, the study area is located in the "parallel ridge-and-valley" region in eastern Sichuan where geomorphic conditions are complicated, and

much of it where the mustard tubers grow is confined to the north bank of Changjiang River. Superior or inferior ecologic environments of the mustard tubers are mainly restricted by gentle hilly country where thicker soil layers often occur on the gentle sunny slopes and are favourable to good quality and high output of the mustard tubers.

Sixthly, Being an important base of material flow and energy flow in ecologic environments of the mustard tubers, the advantageous agricultural geologic background in the Fuling area is one of the main reasons for good quality and high output of the mustard tubers. Only by the combination of geologic background for the growth of the mustard tubers with climatic factor, fine varieties, good fertilizer and field management, can the synthetical natural conditions be made full use of.

Lastly, the superior and inferior regions for the growth of the mustard tubers in the Fuling area have been determined, and the prediction of potential areas for further development have also been worked out.

目 录

前言	1
摘要	1
英文摘要	1
第一章 榨菜菜头有关的农业地质背景现象及问题	1
第一节 菜头分布区的农业地质背景现象	1
第二节 榨菜品质及商品化过程中出现的农业地质背景问题	4
第三节 菜头生态系统中的植物学特征及品种与农业地质背景的相关性	8
第四节 菜头的生理代谢功能与农业地质背景的关系	13
第五节 菜头生态环境的气候条件与地质背景的相关性	16
第六节 菜头生态环境的地下土壤条件与地质背景的关系	20
第七节 农业地质背景含义及其在菜头生态环境和榨菜效益方面的作用	26
第八节 研究方法和采用手段	28
第二章 农业地质背景——土壤母岩及地球化学条件与菜头品质的相关性分析	32
第一节 土壤母岩与菜头菜园土的关系	32
第二节 菜头产区的地球化学特征	48

第三节	元素迁聚对菜头及榨菜的影响·····	61
第三章	农业地质背景——地貌和水文对菜头品质 的制约性·····	68
第一节	地貌变化对菜头生长发育的影响·····	68
第二节	地下水对菜头生态环境及产量品质 影响·····	74
第四章	农业地质背景对菜头影响的综合效应·····	87
第一节	农业地质背景对菜头种植的分布效应·····	87
第二节	农业地质背景对菜头养分的效应·····	89
第三节	农业地质背景对加工榨菜品质的影响·····	111
第五章	榨菜菜头农业地质背景模式及资源性评价·····	115
第一节	菜头生态环境中的农业地质背景模式 探讨·····	115
第二节	菜头地质背景的资源性评价·····	118
第三节	利用农业地质背景法是菜头优质高产的 一项重要措施·····	127
第四节	对榨菜业发展的建议及相关结论·····	129
参考文献	·····	132
[附录一]	榨菜品质的常规指标·····	137
[附录二]	四川涪陵地区菜头用作加工榨菜的主要 品种·····	139
[附录三]	川东主要农业地质背景区菜头菜园土剖 面特征·····	140
[附录四]	菜头及榨菜矿质元素的分析方法·····	141
[附录五]	涪陵榨菜介绍·····	147