

Statistical Analyses of Platycodi Radix Prescription*

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Platycodi Radix prescribed with 17th order of frequency in the prescriptions recorded in *Bang-yag-Hab-pyeon*^{1,14)} is the root of *Platycodon grandiflorum* DE CANDOLLE, and in the Korean Pharmacopoeia²⁾ it is required that the officinal Platycodi Radix should be washed with water, the fine roots removed and dried with phelloderm(rind) as it is or after being removed.

The Platycodi Radix was recorded already in the *Shen-nung-Pen-ts'ao-king*(神農本草經)³⁾ as one of 125 sorts of the third class drugs(下品藥), and in Korea it has been used, from of old, as drug and vegetable food with such Korean indigenous name(鄉藥名, *Hang-yag-myeong*)⁴⁾ as Korean *Idu*(吏讀名) herbal common names, 刀々次·道羅次⁵⁾, 都乙羅叱^{6,7)}, 道乙阿叱⁸⁾.

Thus, compared with the long history of its remedial use, its modern pharmacological study has been comparatively scarce, and it has been considered to have local stimulant expectorant action for its saponin ingredient, but recently Lee⁹⁾ made an extensive report on crude platycodin separated as saponin fraction.

According to synthetical knowledge¹⁰⁾ of Platycodi Radix pharmacological action and its medicinal application described in such *Pen ts'ao* classics(本草書) or Chinese Medical classics as *Shen-nung-Pen-ts'ao-king*, *Pen-ts'ao-Kang-mu*(本草綱目), *Ts'ien-kin-I-fang*(千金翼方), *Dong-eui-Bo-gam*(東醫寶鑑)¹¹⁾, *Hyang-yag-Jib-seong-bang*(鄉藥集成方), etc., the pharmacological action was described as "slightly toxic(有小毒), or innoxious(或無毒), to benefit five viscera(利五臟), to warm center of body(溫中), to invigorate the blood(補血氣), to digest food(消穀), to exterminate poison of worms in the belly(下蟲毒), to reduce phlegm(消痰), to let out pus(排膿), to make up a deficiency(補虛), to nourish the blood(養血), to remove wrong disease(除邪), to keep calm the rush of blood to the head(下氣), to relax the breast(寬胸), to ease the epigastrium(利膈), to clear lungs(清肺), to stop cough(止咳), to alleviate fever(清熱), to lactate(通乳)", and indicated the symptoms for which the Platycodi Radix is efficacious as "tympanites and intestine sound(腹滿腸鳴), convulsive fit(驚悸氣), pain of the side chest(胸脇痛), fever and palsy(寒熱風痺), dyspnea due to cough(咳逆), tumor in the abdomen(癥瘕), pain of chest and abdomen(心腹痛), gastric tumor after chronic dyspepsia(積聚), diarrhea(下痢), acute diarrhea with vomiting(霍亂), muscle cramp(轉筋),

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infantile convulsion(小兒驚癇), lung dyspnea(肺氣促), phlegm(痰涎), five wearinesses and seven hurts(五勞七傷), laryngitis(喉痺), lung tumor (abscess)(肺癰), clogged nostrils(鼻塞), nausea due to weak stomach(寒嘔), sores of tongue and mouth(口舌瘡), blood-shot eyes and pain(赤目腫痛), heavy feeling in the epigastrium and indigestion(胸膈滯氣), prulent sputa(濁唾腫膿)* etc.

In the present study, statistical analyses of Platycodi Radix containing prescriptions were attempted to get a parameter that would be able to indicate the pharmacological activities, as a scientific approach to the materia medica of the oriental medicine. And also, the hierarchial cluster analysis method¹²⁾ was applied in an attempt of the pattern classification of the prescriptions.

METHODS AND MATERIALS

Four hundred and sixty seven prescriptions in the *Bang-yag-Hab-pyeon*(方藥合編) which were used as the materials of my previous studies I and II¹³⁾, and 3484 prescriptions in *Dong-eui-Bo-gam* were used in this study as a random sample of prescriptions of the oriental medicine. Prescriptions from the *Bang-yag-Hab-pyeon*¹⁴⁾ were used for only cluster analysis. Statistical treatment of the materials was followed by the same methods used in the previous studies, and the procedure of hierarchial cluster analysis will be described at the competent section of this paper.

RESULTS AND DISCUSSION

Number of Platycodi Radix Containing Prescriptions—The number of prescriptions by category in the *Bang-yag-Hab-pyeon* is shown in Table I.

In the *Bang-yag-Hab-pyeon*, prescriptions are arranged in three groups, i.e., upper group, middle group and lower group(上統, 中統, 下統), according to their mode of medicinal efficacy. There would be no objection to appraise this classification of prescriptions is very unique and inspiring concept.

The upper group of prescriptions is tonic remedy(補劑), and non-toxic, the middle group is mild remedy(和劑), non-toxic or slightly toxic, and the lower group is attacking remedy(攻劑), of toxic property. This concept of classification can be regarded as an extension of the celebrated arrangement of drugs (not prescribed remedies) under 3 classes by the Shen nung, and reads as follows:¹⁵⁾

Of the first class of drugs there are 120 sorts which are considered to perform the function of 君 Kūn or Sovereigns. They support human life, and thereby resemble Heaven. They are not poisonous. Whatever quantity you take, or howsoever long you use them, they are harmless. If you wish to have the body light, to improve the breath, to live to an old age, without growing old, make use of these drugs of the first class.

There are 120 sorts of drugs of the second class, which are considered to perform the fun-

ctions of 臣 Ch'en or Ministers. They support humane nature, and thereby resemble man. Some of these drugs are harmless; others are poisonous. They ought to be used with direction. If you wish to lessen the violence of diseases and re-establish decayed strength, use the second class of drugs.

There are 125 sorts of drugs of the third class which are considered to perform the function of 佐 Tso, Assistants and 使 Shi, Agents. They cure diseases, and thereby resemble earth. They are very poisonous and ought not to be used continuously. If you wish to drive out cold or heat from the body, or to correct the breath, or to open obstructions, or to heal diseases, use the drugs of this class.

Table I—Number of Platycodi Radix prescriptions by category in "Bang-yag-Hab-pyeon".

Category	Total number of prescription (a)	Number of Platycodi Radix prescriptions (b)	Ratio $(\frac{b}{a}) \times 100$
Upper group	123	4	3.3%
Middle group	181	28	15.5
Lower group	163	17	10.4
Total	467	49	10.5

As shown in Table I, the middle group predominates in the number of frequency, the next is the lower group, and the upper group is the least.

In this context, it can be surmised that Platycodi Radix is not a tonic nor a violent attacking drug, but rather an intermediate mild nature.

The number of Platycodi Radix containing prescriptions recorded in the *Dong-eui-Bo-gam* is shown in Table II.

As shown in Table II, the symptoms or diseases for which the Platycodi Radix is not prescribed are dream, speech, secretion, liver, spleen, gall, stomach, small intestine, large intestine, neck and nape, back, abdomen, navel, loins, bladder, triple warmer, womb, urine, feces, flesh, tendon, hand, foot, hair, pudenda, vomiting, diarrhea, damp, dryness, jaundice, detoxication, first aid etc., and the symptoms and diseases for which the Platycodi Radix is most favorably prescribed are lung, throat and larynx, cough, voice, phlegm, which have the correlation with the diseases of respiratory system, and palsy, internal hurts, plague, carbuncle, boils.

Frequency Distribution of Chinese Characters used for the Expression of Pharmacological Activities and Indications—The Chinese characters which were used for the expression of pharmacological activities and indications of the Platycodi Radix containing prescriptions were treated statistically to get the frequency distribution of their appearance. The number of prescriptions used were 278 from the *Dong-eui-Bo-gam*. Among the Chinese characters, 71 of simple auxiliary words, adverbs, conjunctions and suffixes were excluded from the statistic.

Table II—Number of Platycodi Radix prescriptions in "Dong-eui-Bo-gam".

1. Total number of prescriptions: 3484

2. Number of Platycodi Radix prescriptions: 278

3. Ratio: 8.0%

4. Distribution of Platycodi Radix prescriptions by symptom or disease:

Example: Cough 36 (188, 19.1%)—There are 36 prescriptions containing Platycodi Radix in the chapter of cough, and this number is 19.1% to the total number of prescriptions, 188, in the chapter.

Whole body(身形) 1(24, 4.2%). Spirit(精) 2(40, 5.0%). Breath(Vital force, 氣) 3(43, 7.0%). Nerve(神) 3 (80, 3.8%). Blood(血) 10(89, 11.2%). Dream(夢) 0(10, 0%). Voice(聲音) 9(20, 45.0%). Speech(言語) 0(3, 0%), Secretion(津液) 0(33, 0%). Phlegm(痰飲) 10(62, 16.1%). Liver(肝) 0(5, 0%). Heart(心) 0(5, 0%). Spleen(脾) 0(3, 0%). Lung(肺) 3(3, 100%). Kidney(腎) 0(6, 0%). Gall(膽) 0(2, 0%). Stomach(胃) 0(3, 0%). Small intestine(小腸) 0(2, 0%). Large intestine(大腸) 0(2, 0%). Bladder(膀胱) 0(2, 0%). San Chiao(Triple warmer(三焦) 0(2, 0%). Womb(胞) 0(75, 0%). Parasite(蟲) 2(25, 8.0%). Urine(小便) 0(92, 0%). Feces(大便) 0(190, 0%). Head(頭) 1(77, 2.6%). Face(面) 5(16, 31.3%). Eye(眼) 1(192, 0.5%). Ear(耳) 3(45, 6.7%). Nose(鼻) 4(34, 11.8%). Mouth and tongue(口舌) 5(44, 11.4%). Teeth(牙齒) 1(42, 2.4%). Throat(咽喉) 21(56, 27.5%). Neck and nape(頸項) 0(6, 0%). Back(背) 0(4, 0%). Chest(胸) 5(60, 8.3%). Breasts(乳) 2(23, 8.8%). Abdomen(腹) 0(17, 0%). Navel(臍) 0(7, 0%). Loins(腰) 0(27, 0%). Side chest(脇) 4(14, 28.6%). Skin(皮) 1(40, 2.5%). Flesh(肉) 0(3, 0%). Pulse(脈) 1(4, 25.0%). Tendon(筋) 0(1, 0%). Hand(手) 0(12, 0%). Foot(足) 0(41, 0%). Hair(毛髮) 0(25, 0%). Pudenda(前陰) 2 (80, 2.5%). Anus(後陰) 1(81, 1.2%). Vomiting(吐) 0(18, 0%). Diarrhea(下) 0(16, 0%). Palsy(風) 18(150, 12.0%). Cold(寒) 12(185, 6.5%). The hot weather(暑) 1(32, 3.1%). Damp(濕) 0(25, 0%). Dryness(燥) 0(5, 0%). Fever(火) 6(71, 8.5%). Internal hurt(內傷) 5(28, 17.9%). Infirmity(虛勞) 6(103, 5.8%). Acute diarrhea with vomiting(霍亂) 1(15, 6.7%). Nausea and vomiting(嘔吐) 2(56, 3.6%). Cough(咳嗽) 36(188, 19.1%). Gastric tumor after chronic dyspepsia(積聚) 8(81, 9.9%). Edema(浮腫) 1(36, 2.8%). Tympanites(脹滿) 3(39, 7.7%). Diabetes(消渴) 3(48, 6.3%). Jaundice(黃疸) 0(49, 0%). Malaria(瘧癘) 3(72, 4.2%). Plague(瘟疫) 13(41, 31.7%). Evil spirits(邪祟) 1(7, 14.3%). Carbuncle(癰疽) 21(164, 12.8%). Boils(諸瘡) 9(162, 5.6%). Injury(諸傷) 1(35, 2.9%). Detoxication(解毒) 0(10, 0%). First aid(救急) 0(8, 0%). Miscellaneous(雜方) 1(36, 2.8%). Woman(婦人) 11(132, 8.3%). Pediatrics(小兒) 15(195, 7.7%).

1) Number of Chinese characters used: 557

Compared with 380 which were appeared in the Ginseng prescriptions, this larger number was due to partly the *Bang-yag-Hab-pyeon* itself which had much simpler descriptions than those of the *Dong-eui-Bo-gam*, but mainly the larger variety of Platycodi Radix in its pharmacological activities than Ginseng.

2) Chinese characters of high frequency: (Numerical number in the parenthesis indicates the frequency of appearance of it).

痛(75), 熱(69), 痰(53), 氣(51), 風(47), 嗽(46), 腫(34), 血(33), 塞(33), 虛(29), 肺(29), 咳(28), 瘡(28), 咽(28), 傷(28), 癰(27)……

Compared these with the order of Ginseng prescriptions, 虛, 氣, 塞, 血, 熱, 心, 痛, 風, 胃, 脾..., a great disparity, needless to have rank correlation test, is noticeable.

3) Chinese characters related to cough: 嗽(46), 咳(28), 喘(22), 聲(11), 哮(2), 吼(1). Total frequency...110.

4) Chinese characters related to sputum: 血(81), 痰(53), 咯(15), 結(12), 痞(10), 塞(9), 唾(8), 鬱(7), 涎(6), 壅(5), 吐(5), 膿(4). Total frequency...215.

5) Chinese characters related to respiratory organs: 肺(29), 咽(28), 胸(21), 心(21), 喉(20), 脇(7), 肋(1). Total frequency...127.

6) Chinese characters related to swelling, furuncle and carbuncle: 腫(34), 瘡(28), 癰(27), 膿(14), 痘(8), 疽(1). Total frequency...112.

7) Chinese characters related to fever: 熱(69), 火(13), 瘧(12), 瘧(6). Total frequency...100.

8) Chinese characters related to pain: 痛(include 疼) (75). Total frequency...75.

Putting the results of 3) to 8) together, they will be divided into A, B, C, D four categories:

A. Chinese characters used for the characteristic symptoms of inflammation, fever, swelling, and pain: 287 (fever...100, swelling...112, pain...75).

B. Chinese characters related to respiratory organs (thorax, lung, larynx, etc.) as the diseased parts: 127 (vid. 5).

C. Chinese characters related to cough: 99 (vid. 3).

D. Chinese characters related to sputum: 215 (vid. 4).

According to Chinese dictionary, 咳 means dry barking cough without expectoration, 嗽 no barking but only sputum, and it is notable that the frequency of 嗽 is prevail over that of 咳. There appeared such Chinese characters which related to the difficulty of expectoration as 喘, 塞, 痞, 壅, 鬱 quite much, and such suggest that the cough accompanying sputum expectoration difficulty is the main indication of Platycodi Radix.

Summarizing collectively the four categories of indications, i.e., inflammation, respiratory organ disorders, cough, and sputum, the main indication for Platycodi Radix can be expressed as "inflammations of respiratory organs which have the main symptoms of cough and sputum".

This kind of inductive method is based on the concept of "Canonical Analysis" in statistics.

Medication Dose of Platycodi Radix—Two hundred and twenty six prescriptions out of 278 prescriptions which contain Platycodi Radix in *Dong-eui-Bogam* were treated statistically to get medication dose statistic of the drug. Fifty two of 278 prescriptions were excluded from the study by reason of uncertainty of their dose descriptions.

As shown in Table III, average single dose is 8.3分 bun (=3.11 g), and such average dose is administered twice a day, then they correspond to 6.22 g which coincide with the daily dose in the Korean Pharmacopoeia.

In order to know about whether there is disparity in dosage according to the kinds of indications by diseases, the prescriptions were classified by 5 kinds of indications, cough, furuncle and carbuncle, fever, blood, cold; and the average doses for those group of prescriptions

Table III—Frequency distribution of Platycodi Radix dose

Class(Unit: 分 Bun) =0.375 g	Frequency	Statistical characteristics
0~3	15	Mean: 8.3(=3.11g)
3~6	56	Minimum: 1.0(=0.375 g)
6~9	57	Maximum: 100.0(=37.5 g)
9~12	73	Mode: 10.5 (=3.94 g)
12~15	2	
15~18	11	
18~21	7	
21~24	1	
(4~27	1	
.....	...	
30~33	1	
.....	...	
36~39	1	
99~102*	1	
Total	226	

*This class is rejected in the computation of mean value.

were computed, and the results: cough...9.8分=3.68 g, furuncle and carbuncle...6.3分=2.36 g, fever...6.4分=2.44 g, blood...6.4分=2.4 g, cold...8.2分=3.08 g, and the results show that in case of cough the dosage was greatest which coincide with the fact that the main efficacy of Platycodi Radix is as an expectorant.

Compatibility of Platycodi Radix—In order to confirm the relations of 單行(single use), 相須(mutual indispensability), 相使(compatibility), 相畏(mutual fear), 相惡(mutual hatred), 相殺(mutual cancellation), 相反(incompatible) which are the compatibility concepts in the materia medica of oriental medicine, statistically gathered such compatible drugs with Platycodi radix from the 278 prescriptions.

Numerical number in the parenthesis of each drug indicates the frequencies of appearance in the prescriptions.

The list of compatible drugs with Platycodi Radix:

Glycyrrhizae Radix(236), Zingiberis Rhizoma(136), Hoelen(119), Ginseng Radix(109), Aurantii pericarpium(94), Scutellariae Radix(94), Angelicae gigantis Radix(89), Cnidii Rhizoma(88), Philopteri Radix(80), Pinelliae Tuber(78), Paeoniae Radix(78), Atractylodes Rhizoma(77), Aurantii immaturi Fructus(75), Rehmanniae Rhizoma (57) Menthae Folium (55), Coptidis Rhizoma(53), Gardeniae Fructus(52), Bupleuria Radix(50), Angelicae davuricae Radix(50), Forsythiae Fructus(48), Mori Cortex Radicis(45), Zizyphi inermi Fructus(41), Zingiberis Rhizoma, steam dried(41), Armeniacae Semen(40), Fritillariae Tuber(40), Trichosanthes Semen(40), Anemarrhenae Rhizoma(37), Anglicae koreanae Radix(35), Cinnamomi

cortex(35), Nepetae Herba(34), Liriope Tuber(32), Astragali Radix(32), Perillae Folium (30), Asiasari Radix(30), Ephedrae Herba(28), Schizandrae Fructus(28), Cimicifugae Rhizoma (27), Aurantii Pericardium (unripe, green)(26), Rhei Rhizoma(26), Anthrisci Radix(25), Helenii Radix(23), Magnoleae Cortex(23), Asteris Radix(22), Asparagi Radix(19), Cardamomi Fructus(19), Aurantii immaturi Fructus(17), Cyperi Rhizoma(16), Scrophulariae Radix (16), Gelatinum(16), Mume Fructus(16), Glauber's Salt(16), Lycii Cortex Radicis(16), Araliae Radix(16), Phellodendri Cortex(16), Bardanae Fructus(15), Gypsum(15), Bamboo Oil(12), Petasitis Flos(12), Silkworm corpse died of an infectious disease of botylis basiana (11), Arisaematis Rhizoma(11), Amomi cardamomi Fructus(11), Arecae Semen(11), Xanthoxyli Fructus(11), Gastrodiae Rhizoma(11), Linderae Radix(11), Angelicae tenuissimae Radix(10), Anisomelis Folium(10), Junci Herba(10), Puerariae Radix(9), Akebiae Vitis(9), Acoi graminei Rhizoma(9), Coicis Semen(9), Aconiti Tuber(9), Crotonis Semen(8), Cinnabar (8), Moschus(8), Aconiti Tuber(8), Terminaliae Fructus(7), Moutan Cortex(7), Scirpi Tuber(7), Rhinocerrotis Cornu(7), Zedoariae Rhizoma(7), Gentianae scabrae Radix(7), Polygalae Radix(7), Olibanum(7), Typhae Pollen(7), Gledtsiae Fructus(7), Allium(6), Bambusae Folium(6), Caryophylli Flos(6), Drabae Semen(6), Perillae Semen(6), Alumen (6), Persicae Semen(6), Arecae Pericarpium(6), Nelumbinis Fructus(5), Hordei Fructus Germinatus(5), Massa medicata fermentata(5), Galangae Rhizoma(5), Evodiae Fructus(5), Mel(5), Alismatis Rhizoma(5), Carthami Flos(5), Talcum(5), Inulae Flos(4), Lonicerae Flos (4), Viticis Fructus(4), Myrrha(4), Sinomenii Radix et Caulis(4), Dolichi Semen(4), Testudinis Testa(4), Belamcandae Rhizoma(4), Sappan Lignum(4), Papaveris Fructus(4), Clematidis Radix(4), Indigo pulverata Levis(4), Lilium Bulbus(4), Buthus(4), Curcumae aromatica Rhizoma(3), Chrysanthemi Flos(3), Gold Foil(3), Oryzae Semen Glutinosa(3), Sojae Sprout(3), Anisi Stelati Fructus(3), Ampelopidis Radix(3), Corydalis Tuber(3), Borneol (3), Zingiberis nigri Fructus(3), Lithospermi Radix(3), Bambusae caulis in Taeniam(3), Justiciae Radix(3), Tribuli Fructus(3), Amomi costati Fructus(3), Aloes lignum (aquillaria)(3), Tetrapanacis Medulla(3), Exviae of Cicada(3), Aristolochia Fructus(3), Gluberite (2), Laminaria(2), Imperatae Hizoma(2), Zizyphi spinosi Semen(2), Triticum Semen(2), Benzoar Orientale(2), Achyranthis Radix(2), Realgar(2), Minium(2), Sanguisorbae Radix (2), Juglandis Semen(2), Shell Powder(2), Sophorae Radix(2), Chinese Ink-stick(2), Urine of Infant(2), Bletilla striata Radix(2), Biota orientalis Folium(2), Lycopus Lucidus (2), Corni Fructus(2), Isatis japonica Radix(2), Eucommiae Cortex(2), Paper on which silkworm egg deposited(2), Sal(2), Sophorae Flos(1), Cassiae Semen(1), Meliae Cortex(1), Dianthi Semen(1), Salviae miltiorrhizae Radix(1), Red Hematite(1), Euphorbiae Radix(1), Santali Lignum album(1), Raphani Semen(1), Antelopis Cornu(1), Ostreae Testa(1), Equisetum hyemalae Herba(1), Agkistnodron(1), Resina Calophylli(1), Acanthopanax Cortex (1), Sucrosum(1), Lonicerae Caulis(1), Hominis Placenta(1), Sargassi Thallus(1), Piperis nigri Fructus(1), Melia Semen(1), Phlomidis Radix(1), Tokoro' Rhizoma(1), Nelumbinis Rhizoma(1), Gysin Semen (black)(1), Thujae Semen(1), Crataegi Fructus(1), Discoreae Rhizoma(1), Dendrobii Herba(1), Myristicae Semen(1), Baschniakiae Herba(1), Prium

Fructus(1), *Phaseoli Semen rubra*(1), *Gleditschiae Spina*(1), *Plantaginis Semen*(1), *Maritis Squana*(1), *Melonis Calyx*(1), *Drynaria fortunei Herba*(1), *Cirsii Rhizoma*(1), *Polygoni Radix*(1), *Magnoliae Flos*(1), *Scolopendria*(1), *Mica*(1), *Aconiti Radix (Cho-O)*(1), *Leonuri Semen*(1), *Sesami Semen*(1), *Reynoutriae Radix*(1), *Cynanchi Radix*(1), *Ulmi Semen*(1), *Albiziae Cortex*(1), *Phaseoli Semen rubra*(1), *Lasiosphaera*(1), *Kaki Calyx*(1), *Rhyncho-phyllae Cortex*(1), *Buddleja officinalis Flos*(1), *Mercury*(1), *Hirudo*(1), *Resin of pinus sp.* (1), *Resin of calamus draco*(1), *Brown hematite*(1), *Preparation made of faeces*(1), *Eupatorium fortunei*(1), *Saussurea tanakae Radix*(1), *Boehmeria Radix*(1), *Gambir*(1), *Magnolia liliflora Cortex*(1), *Coprophaginae*(1), *Imago of pabanus sp.*(1), *Salix Cortex*(1), *Semen of zanthoxylum planispinum*(1), *Daphne genkwa Flos*(1), *Phaseoli Semen rubra*(1), *Lasiosphaera*(1), *Kaki Calyx*(1), *Thea sinensis Folium*(1), *Malted Sugar*(1).

The number of 246 kinds of drugs that compounded with *Platycodi Radix* is much more than 175 kinds that compounded with *Ginseng*. Twenty kinds of drugs that are most frequently compatible with *Platycodi Radix* in frequency order are as follows:

1. *Glycyrrhizae Radix*, 2. *Zingiberis Rhizoma*, 3. *Hoelen*, 4. *Ginseng*, 5. *Aurantii pericarpium*, 6. *Scutellariae Radix*, 7. *Angelicae gigantis Radix*, 8. *Cnidii Rhizoma*, 9. *Phellopteri Radix*, 10. *Pinelliae Tuber*, 11. *Paeoniae Radix*, 12. *Atractylodes Rhizoma*, 13. *Ponciri Fructus*, 14. *Rehmanniae Rhizoma*, 15. *Menthae Folium*, 16. *Gardniae Fructus*, 17. *Coptidis Rhizoma*, 18. *Bupleuri Radix*, 19. *Angelicae devuricae Radix*, 20. *Forsythiae Fructus*.

To compare with this, 20 kinds of drugs that are compatible with *Ginseng* in frequency order are as follows:

1. *Glycyrrhizae Radix*, 2. *Hoelen*, 3. *Atractylodes Rhizoma*, 4. *Angelicae gigantis Radix*, 5. *Aurantii Pericarpium*, 6. *Paeoniae Radix*, 7. *Pinelliae Tuber*, 8. *Cnidii Rhizoma*, 9. *Rehmanniae Rhizoma*, 10. *Astragali Radix*, 11. *Cinnamomi Cortex*, 12. *Bupleuri Radix*, 13. *Zingiberis Rhizoma*, 13. *Liriopes Tuber*, 15. *Scutellariae Radix*, 16. *Helenii Radix*, 17. *Aconiti Tuber*, 18. *Phellopteri Radix*, 19. *Cimicifugae Rhizoma*, 20. *Schizandreae Fructus*.

Among the each 20 kinds of the two groups, 13 of them were in common, and this fact suggested that there are such basic drugs with high frequency of occurrence in any prescriptions, but so far as there was no Spearman's rank correlation between these two groups, there should be some disparity between the drug group compatible with *Platycodi Radix* and the one compatible with *Ginseng*. Conclusion should be made after having further detailed statistical analysis, but in general, *Platycodi Radix* seemed to be compatible with any drugs without incompatibility.

Classification of *Platycodi Radix* Prescriptions—Under an assumption that if there were any principle for the formulation of prescriptions in the Oriental medicine, it might be able to get a classification corresponding to indicated syndromes according to the pattern similarity of prescriptions. The Similarity ratio was used as numerical expression of degree of similarity between prescriptions

Assuming that the compositions of prescription α and β are respectively $(x_{\alpha 1}, x_{\alpha 2}, \dots, x_{\alpha p})$, $(x_{\beta 1}, x_{\beta 2}, \dots, x_{\beta p})$, and x denotes each drug consisted, and a certain drug appearance in a

prescription is expressed as (1), nonexistence as (0). With such (0—1) type expression, prescriptions are formulated as follows:

$$(x_{\alpha_1}, x_{\alpha_2}, x_{\alpha_p}) = (1, 0, 0, 1, 1, 1)$$

$$(x_{\beta_1}, x_{\beta_2}, x_{\beta_p}) = (1, 1, 0, 0, 1, 1)$$

Then, the similarity ratio between two prescriptions like these expressed:

$$\rho_{\alpha\beta} = \frac{a}{a+b+c}$$

where, a : number of variable pairs whose both variables are (1)

$$= \sum_{i=1}^p x_{\alpha_i} x_{\beta_i}$$

b : number of variable pairs whose α is (1), β is (0)

$$= \sum_{i=1}^p x_{\alpha_i} (1 - x_{\beta_i})$$

c : number of variable pairs whose α is (0), β is (1)

$$= \sum_{i=1}^p (1 - x_{\alpha_i}) x_{\beta_i}$$

Thus getting the similarity ratios between prescriptions, tried to classify prescriptions and to find out the kinships of them by getting dendrogram, processing hierarchial cluster analysis following a certain algorithm. Recognizing each prescription as an independent cluster, underwent the process of making a dendrogram of the results obtained by repeating the process of fusing the largest similarity ratio into a cluster.

For the distance between newly formed cluster and other ones the concept of "nearest neighbour" was applied. When cluster C_h and C_l were fused into C_f , the distance between C_f and C_i ($f \neq h, l$) is $D_{fi}^{(i+1)}$

$$D_{fi}^{(i+1)} = \text{Min. } \{D_{fh}^{(i)}, D_{fl}^{(i)}\}$$

When the number of prescriptions to be treated are n , the fusion manipulation should be repeated $(n-1)$ times to be enormous computation necessitating the use of computer, but in this study 49 prescriptions recorded in *Bang-yag-Hab-pyeon*, in a sense of preliminary examination of the necessity of such prescription cluster analysis.

The names of prescriptions which were treated and the serial number of individual prescription of them are as follows:

1. 加味逍遙散 Ga-mi-so-yo-san, 2. 加味溫膽湯 Ga-mi-on-dam-tang, 3. 加味二陳湯 Ga-mi-i-jin-tang, 4. 葛根解肌湯 Gal-geun-hai-gi-tang, 5. 甘桔湯 Gam-gil-tang, 6. 開氣消痰湯 Gai-gi-so-dam-tang, 7. 瓜蒌枳實湯 Gwa-ru-ji-sil-tang, 8. 藿香正氣散 Gwg-hyang-jeong-gi-san, 9. 桔梗枳殼湯 Gil-gyeong-ji-gag-tang, 10. 桔梗湯 Gil-gyeong-tang, 11. 大異香散 Dai-i-hyang-san, 12. 大七氣湯 Dai-chil-gi-tang, 13. 薄荷煎元 Bag-ha-jeon-weon, 14. 半夏溫肺湯 Ban-ha-on-pe-tang, 15. 防風通聖散 Bang-pung-tong-seong-san, 16. 茯苓補心湯 Bog-ryeong-bo-sim-tang, 17. 分氣飲 Bun-gi-eum, 18. 分心氣飲 Bun-sim-gi-eum, 19. 蓼苳湯 Sam-gi-tang, 20. 蓼苓白朮散 Sam-ryeong-baig-chul-san, 21. 蓼蘇飲 Sam-so-eum, 22. 三合湯 Sam-hab-tang, 23. 星香正氣散

Seong-hyang-jeong-gi-san, 24. 洗肝明目湯 Se-gan-myeong-mog-tang, 25. 消毒保嬰丹 So-dog-bo-yeong-dan, 26. 柴梗半夏湯 Si-gyeong-ban-ha-tang, 27. 十六味流氣飲 Sib-yug-mi-yu-gi-eum, 28. 靈仙除痛飲 Yeong-seon-je-tong-eum, 29. 五福化毒丹 O-bog-hwa-dog-dan, 30. 烏藥順氣散 O-yag-sun-gi-san, 31. 五積散 O-jeog-san, 32. 龍腦膏 Yong-noi-go, 38. 牛黃清心元 U-hwang-cheong-sim-weon, 34. 理氣祛風散 I-gi-geo-pung-san, 35. 人參羌活散 In-sam-gang-hwal-san, 36. 人參敗毒散 In-sam-pai-dog-san, 37. 紫菀湯 Ja-weon-tang, 38. 倉廩湯 Chang-reum-tang, 39. 清金降火湯 Cheong-geum-gang-hwa-tang, 40. 清肌散 Cheong-gi-san, 41. 清上防風湯 Cheong-sang-bang-pung-tang, 42. 清上補下丸 Cheong-sang-bo-ha-hwan, 43. 托裡消毒飲 Tag-ri-so-dog-eum, 44. 必用方甘桔湯 Pil-yeong-bang-gam-gil-tang, 45. 解表二陳湯 Hai-pyo-i-jin-tang, 46. 荊芥連翹湯 Hyeong-gai-ryeon-gyo-tang, 47. 黃芩湯 Hwang-geum-tang, 48. 回首散 Hoi-su-san, 49. 回春涼膈散 Hoi-chun-yang-gyeong-san.

The calculated similarity ratios among the 49 prescriptions are shown in Table IV. Dendrogram of Platycodi Radix prescriptions showing the result of cluster analysis is in Fig. 1 which was too complicatedly branched out not to be easily found its clear systematic clusters except only some local ones. At this stage of situation, it should be reserved to make any decisive conclusion, although it might be able to extract such prescription forming principles only through further comprehensive study using computer.

Assuming that the reason why a clear classification has not been made yet was due to the lack of identification method of prescription pattern by the mathematical expression, it should be developed to make a more effective programming for statistical treatment of prescriptions.

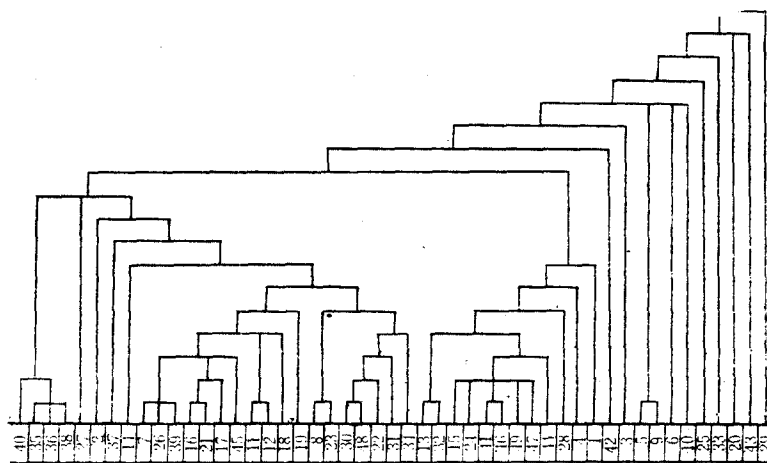


Fig. 1—Dendrogram of Platycodi Radix prescriptions.

RESULTS AND DISCUSSION

1. Number of Platycodi Radix prescriptions recorded in *Bang-yag-Hab-pyeon* is 49, and 278 in the *Dong-eui-Bo-gam*.

2. Indicated categories of symptoms and diseases for which the prescriptions are described

are lung, larynx, cough, voice, sputum and other respiratory diseases, wind 風, internal lesion 內傷, feverish diseases (plague) 瘟疫, furuncle and carbuncle 癰疽, various ulcers and abscesses 諸瘡, etc.

3. Examining the frequency distribution of Chinese characters used for denoting the indications of Platycodi Radix prescriptions, those for the three main symptoms of inflammation, fever, swelling, and pain reached to total 287, the highest frequency, those for sputum 215, those for the diseases of chest, lung, larynx, etc., 127, and those for cough 99; from such context, Platycodi Radix has been considered in the Oriental Materia Medica to be a curative for such respiratory inflammations which have the symptoms of cough and sputum (or bloody sputum).

4. Average single dose of Platycodi Radix is 8.3 bun (3.11g), minimum dose 1 bun (0.38g), maximum dose 1 ryang (10 bun, 37.5g), its larger dosage was tended to be prescribed for cough symptoms.

5. Platycodi Radix is compatible with 246 kinds of drugs and has comparatively almost no incompatibility.

6. Although the result of cluster analysis of Platycodi Radix prescriptions with similarity ratio as distance barometer between prescriptions has shown slight cluster formation, such numerical taxonomy concept for the classification of prescription patterns would be worthy of further study.

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