

The Mapping between Traditional Chinese Medicine and Signaling Molecules

The Mapping between Traditional Chinese Medicine and Signaling Molecules

By

Yang Liu

**Cambridge
Scholars
Publishing**



The Mapping between Traditional Chinese Medicine and Signaling
Molecules

By Yang Liu

This book first published 2022

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Copyright © 2022 by Yang Liu

All rights for this book reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owner.

ISBN (10): 1-5275-8574-3

ISBN (13): 978-1-5275-8574-4

CONTENTS

Preface	xiv
Chapter 1	1
Introduction	
1.1 TCM vital substances related to mood, TCM thin fluid, and TCM thick fluid.....	4
1.2 Qi, Zong Qi, Glory Qi, Nutrient Qi, Defending Qi, Yin Qi and Yang Qi	5
1.3 Yin, Yang, Qi in Five Zang-Organs (Five Groups, 五行)	6
1.4 Six Qis (Six Evils, 六邪): TCM vital substances related to environment.....	8
1.5 Clear Qi, Turbid Qi, Righteous Qi, Evil Qi, Stomach Qi, Genuine Qi, Blood Qi, Essence Qi, Indulged Qi, and Mind Qi.....	9
1.6 Consumption (消) and Central (中)	10
1.7 The methods to identify the mapping between signaling molecule and TCM vital substance	11
Chapter 2	14
The mappings of TCM vital substances related to mood, TCM thin fluid, and TCM thick fluid	
2.1 TCM Essence (Jing, 精) corresponds to tyrosine.....	14
2.1.1 Comparison between TCM Essence and Tyrosine.....	14
2.1.2 Essence dispersion 精散.....	19
2.1.3 Effect of TCM herbal medicines on Essence and Tyrosine..	20
2.2 TCM Mind (Shen, 神) corresponds to Melatonin	23
2.2.1 Comparison between TCM Mind and Melatonin	23
2.2.2 Effect of TCM herbal medicines on TCM Mind and Melatonin	27
2.3 TCM Ethereal Soul (Hun 魂) corresponds to Serotonin	27
2.3.1 Comparison between TCM Ethereal Soul and Serotonin	27
2.3.2 Effect of TCM herbal medicines on TCM Ethereal Soul and Serotonin.....	30
2.4 TCM Corporeal Soul (Po 魄) corresponds to Cysteine.....	31
2.4.1 Comparison between TCM Corporeal Soul and Cysteine....	31

2.4.2 Effect of TCM herbal medicine on TCM Corporeal Soul and Cysteine	34
2.5 TCM Ideation (Yi 意) corresponds to Tryptophan	35
2.5.1 Comparison between TCM Ideation and Tryptophan	35
2.5.2 Effect of TCM herbal medicine on TCM ideation and tryptophan	38
2.6 “TCM Will (Zhi 志)” corresponds to Arginine.....	38
2.6.1 Comparison between “TCM Will” and Arginine	38
2.6.2 Effect of TCM herbal medicine on “TCM Will” and arginine	43
2.7 TCM thin fluid (Jin 津) corresponds to protein	43
2.7.1 Comparison between TCM thin fluid and protein	43
2.7.2 Effect of TCM herbal medicine on TCM thin fluid and protein.....	47
2.8 TCM thick fluid (Ye 液) corresponds to lipid.....	49
2.8.1 Comparison between TCM thick fluid and lipid	49
2.8.2 Effect of TCM herbal medicine on TCM thick fluid and lipid	54
Chapter 3	57
Qi, Zong Qi, Nutrient Qi, Glory Qi, Defending Qi, Yin Qi and Yang Qi	
3.1 Qi corresponds to Sodium.....	57
3.1.1 Comparison between Qi and Sodium	57
3.1.2 Effect of TCM herbal medicine on Qi and Sodium.....	70
3.2 Zong Qi (宗氣) corresponds to Dopamine.....	70
3.2.1 Comparison between Zong Qi and Dopamine (DA)	70
3.2.2 Effect of TCM herbal medicine on Zong Qi	73
3.3 Nutrient Qi (營氣) corresponds to cAMP	74
3.3.1 Comparison between Nutrient Qi and cAMP	74
3.3.2 Effect of TCM herbal medicines on Nutrient Qi	78
3.4 Glory Qi (榮氣) corresponds to Adenosine Triphosphate (ATP) .	79
3.4.1 Comparison between Glory Qi and ATP.....	79
3.4.2 Effect of TCM herbal medicines on Glory Qi	82
3.4.3 The clarification of Nutrient Qi and Glory Qi	83
3.5 Defending Qi (衛氣) corresponds to Chloride (Cl)	84
3.5.1 Comparison between Defending Qi and Chloride.....	84
3.5.2 Effect of TCM herbal medicines on Defending Qi and Chloride	92
3.6 Yin Qi (陰氣) corresponds to Potassium	93

3.6.1 Physiological functions of Yin Qi (阴气) in YEIC	93
3.6.2 Effect of TCM medicine on “Yin Qi” and Potassium	97
3.7 Yang Qi (阳气) corresponds to Calcium	98
3.7.1 Physiological functions of Yang Qi (阳气) in YEIC.....	98
3.7.2 Effect of TCM medicine on “Yang Qi” and Calcium	104
Chapter 4	106
Mappings of Yin, Yang, Qi in Five Groups	
4.1 Heart Group Mapping	108
4.1.1 Statement of YEIC on Heart organ and physiological reality	109
4.1.2 Heart Qi (心气) corresponds to Magnesium	112
4.1.3 Heart Yang (心阳) corresponds to IGF-1	115
4.1.4 Heart Yin (心阴) corresponds to Angiotensin II	120
4.1.5 Contrary effects of Heart Yang (IGF-1) and Heart Yin (Angiotensin).....	122
4.1.6 Summary of Heart Group Mapping.....	123
4.2 Spleen Group Mapping	124
4.2.1 Statement of YEIC on Spleen organ and physiological reality	125
4.2.2 Spleen Qi (脾气) corresponds to Ghrelin	128
4.2.3 Spleen Yang (脾阳) corresponds to Atrial natriuretic peptide (ANP).....	133
4.2.4 Spleen Yin (脾阴) --- Retinoic Acid	135
4.2.5 Central (中) or Spleen Yin (脾阴) --- Aldosterone	140
4.2.6 Contrary effects among Spleen Yang (ANP), Spleen Yin (Retinoic Acid) and “Central” (Aldosterone)	143
4.2.7 Summary of Spleen Group Mapping.....	145
4.3 Lung Group Mapping	145
4.3.1 Statement of YEIC on Lung organ and physiological reality	146
4.3.2 Lung Qi (肺气) corresponds to HIF	148
4.3.3 Lung Yang (肺阳) corresponds to VEGF.....	153
4.3.4 (Another possible) Lung Yang (肺阳) corresponds to FGF7.....	156
4.3.5 Lung Yin (肺阴) corresponds to Ascorbic Acid.....	158
4.3.6 Contrary effects of Lung Yang and Lung Yin.....	161
4.3.7 Summary of Lung Group Mapping	162
4.4 Kidney Group Mapping	163

4.4.1 Statement of YEIC on Kidney organ and physiological reality	163
4.4.2 Kidney Qi (肾气) corresponds to Nitric Oxide (NO)	168
4.4.3 Kidney Yang (肾阳) corresponds to Calcitonin	173
4.4.4 (Another) Kidney Yang (肾阳) corresponds to PTHrP	176
4.4.5 Kidney Yin (肾阴) corresponds to Wnt	179
4.4.6 Contrary effects of Kidney Yang and Kidney Yin	182
4.4.7 Summary of Kidney Group Mapping	184
4.5 Liver Group Mapping	185
4.5.1 Statement of YEIC on Liver organ and physiological reality	185
4.5.2 Liver Qi (肝气) corresponds to Glutathione (GSH)	189
4.5.3 Liver Yang (肝阳) corresponds to Erythropoietin (EPO) ..	194
4.5.4 Liver Yang (肝阳) corresponds to Hepatocyte Growth Factor (HGF)	198
4.5.5 Liver Yin (肝阴) corresponds to Superoxide Dismutase (SOD)	201
4.5.6 Liver Yin (肝阴) corresponds to Renin	204
4.5.7 Contrary effects of Liver Yang and Liver Yin	207
4.5.8 Summary of Liver Group Mapping	209
Chapter 5	210
The mapping of Six Qis (Evils)	
5.1 “Cold Evil” (寒邪) corresponds to IL-1	211
5.1.1 Physiological functions of Cold Evil” (寒邪) in YEIC	212
5.1.2 Typical manifestation of “Cold Evil”	221
5.1.3 Effect of TCM herbal medicine on “Cold evil” and IL-1 ...	222
5.2 “Damp Evil” (湿邪) corresponds to IL-6	223
5.2.1 Physiological functions of “Damp Evil” (湿邪) in YEIC ..	223
5.2.2 Typical manifestation of “Damp Evil”	228
5.2.3 Effect of TCM herbal medicine on “Damp Evil” and IL-6 ..	229
5.3 “Dry Evil” (燥邪) corresponds to IL-8	230
5.3.1 Physiological functions of “Dry Evil” (燥邪) in YEIC	230
5.3.2 Typical manifestation of “Dry Evil”	236
5.3.3 Effect of TCM herbal medicine on “Dry Evil” and IL-8	237
5.4 “Heat Evil” (热邪) corresponds to TNF- α	238
5.4.1 Physiological functions of “Heat Evil” (热邪) in YEIC	238
5.4.2 Typical manifestation of “Heat Evil”	243

5.4.3 Effect of TCM herbal medicine on “Heat Evil” and TNF- α	246
5.4.4 The TCM syndrome “Heat Central” (热中)	246
5.5 “Wind Evil” (风邪) corresponds to NF- κ B	251
5.5.1 Physiological functions of “Wind Evil” (风邪) in YEIC ...	251
5.5.2 Typical manifestation of “Wind Evil”	257
5.5.3 Effect of TCM herbal medicine on “Wind Evil” and NF- κ B	260
5.6 “Summerheat Evil” (暑邪) corresponds to Cyclooxygenase-2 (COX-2)	260
5.6.1 Physiological functions of “Summerheat Evil” (暑邪) in YEIC	261
5.6.2 Typical manifestation of “Summerheat Evil”	263
5.6.3 Effect of TCM herbal medicine on “Summerheat Evil” and COX-2	265
Chapter 6	266
Clear Qi, Turbid Qi, Righteous Qi, Evil Qi, Stomach Qi, Genuine Qi, Blood Qi, Essence Qi, Indulged Qi, and Mind Qi	
6.1 “Clear Qi (清气)” corresponds to TLR4	266
6.1.1 Physiological functions of “Clear Qi (清气)” in YEIC	266
6.1.2 Effect of TCM herbal medicine on “Clear Qi” and TLR4 ..	270
6.2 “Turbid Qi (浊气)” corresponds to Leptin	271
6.2.1 Physiological functions of Turbid Qi (浊气) in YEIC	271
6.2.2 Effect of TCM medicine on Turbid Qi (浊气) and Leptin ..	272
6.3 Righteous Qi (正气) Corresponds to Immunoglobulin G (IgG) ..	273
6.3.1 Physiological functions of Righteous Qi (正气) in YEIC ..	273
6.3.2 Effect of TCM medicine on Righteous Qi and IgG	276
6.4 Evil Qi (邪气) Corresponds to Lipopolysaccharide (LPS)	276
6.4.1 Physiological functions of Evil Qi (邪气) in YEIC	276
6.4.2 Effect of TCM medicine on Evil Qi and LPS	280
6.5 “Stomach Qi (胃气)” corresponds to Amylase	280
6.5.1 Physiological functions of Stomach Qi (胃气) in YEIC	281
6.5.2 Effect of TCM medicine on Stomach Qi and Amylase	282
6.6 “Genuine Qi (真气)” corresponds to Phosphorus	284
6.6.1 Physiological functions of Genuine Qi (真气) in YEIC	284
6.6.2 Opinions on Genuine Qi (真气)	286
6.6.3 Effect of TCM medicine on Genuine Qi and Phosphorus ..	287
6.7 Blood Qi (血气) corresponds to Iron	289

6.7.1 Physiological functions of Blood Qi (血气) in YEIC	289
6.7.2 Effect of TCM medicine on Blood Qi and Iron.....	292
6.8 Essence Qi (精气) corresponds to Zinc	293
6.8.1 Physiological functions of Essence Qi (精气) in YEIC	293
6.8.2 Effect of TCM medicine on Essence Qi and Zinc.....	298
6.9 Indulged Qi (淫气) corresponds to Gonadotropin-releasing hormone (GnRH).....	299
6.9.1 Physiological functions of Indulged Qi (淫气) in YEIC	299
6.9.2 Effect of TCM medicine on Indulged Qi and GnRH	304
6.10 Mind Qi (神气) corresponds to Thyroid Hormone (TH)	305
6.10.1 Physiological functions of Mind Qi (神气) in YEIC.....	306
6.10.2 Effect of TCM medicine on Mind Qi and Thyroid Hormone	309
Chapter 7	311
The Relationship between Six Qis (Evils) and Five Zang (Group)	
7.1 SW23: Effects of Six Evils on Five Zang Organs.....	312
7.2 SW69: Effects of Excessive Five Groups on Six Evils and Five Zang Organs.....	313
7.2.1 Excessive “Liver group” enhances Wind Evil (NF-κB) then offends Spleen Organ.....	315
7.2.2 Excessive “Heart group” enhances Summerheat Evil (COX-2) then offends Lung Organ.....	316
7.2.3 Excessive “Spleen group” enhances Damp Evil (IL-6) then offends Kidney Organ.....	317
7.2.4 Excessive “Lung group” increases Dry Evil (IL-8) then offends Liver Organ.....	318
7.2.5 Excessive “Kidney group” increases Cold Evil (IL-1) then offends Heart Organ.....	318
7.3 SW74: Inter-relationship among Six Evils and Their Effect on Five Zang Organs	319
7.3.1 Clear Qi (TLR4)→ Dry Evil (IL-8) → Wind Evil (NF-κB) → Liver disease pathway.....	321
7.3.2 Heat Qi (TNFα)→ Heart Group (Ang II) → Dry Qi (IL-8) → Lung disease.....	322
7.3.3 Cold Qi (IL-1) → Kidney Group (Wnt) → Heat Qi (TNFα) → Heart disease	324
7.3.4 Damp Qi (IL-6) → Spleen Group (Aldosterone) → Cold Qi (IL-1) → Kidney disease.....	325

7.3.5 Wind Qi (NF- κ B) \rightarrow Liver Group (HGF) \rightarrow Damp Qi (IL-6) \rightarrow Spleen disease	327
7.4 SW69: Effect of Deficient Five Groups on Six Evils	328
7.4.1 Liver Group (GSH/EPO) is deficient, then Dry Evil (IL-8) is greatly vigorous	329
7.4.2 Heart Group (Mg/IGF) is deficient, then Cold Evil (IL-1) is greatly vigorous	330
7.4.3 Spleen Group (ANP/ghrelin/retinoic acid) is deficient, then Wind Evil (NF- κ B) is greatly vigorous	330
7.4.4 Lung Group (VEGF) is deficient, then “Flame and Fire (COX-2/TNF α)**” are vigorous	330
7.4.5 Kidney Group (Wnt) is deficient, then Damp Evil (IL-6) is greatly vigorous	331
7.5 Summary	331
Chapter 8	333
Molecular mechanism of TCM herbal formulas for treating arthritis	
8.1 “Migratory arthralgia” dominated by “Wind Evil” (NF- κ B)	336
8.1.1 TCM strategy to treat “Migratory arthralgia”	337
8.1.2 TCM herbal formula to treat “Migratory arthralgia”	338
8.2 “Painful arthritis” dominated by “Cold Evil” (IL-1)	341
8.2.1 TCM strategy to treat “Painful arthritis”	341
8.2.2 TCM herbal formula to treat “Painful arthralgia”	342
8.3 “Damp arthralgia” dominated by “Damp Evil” (IL-6)	344
8.3.1 TCM strategy to treat “Damp arthralgia”	344
8.3.2 TCM herbal formula to treat “Damp arthralgia”	345
8.4 “Heat arthralgia” dominated by “Heat Evil” (TNF- α)	348
8.5 Conclusion	350
Chapter 9	351
Treating constipation by manipulating Lung Qi (HIF)	
9.1 The mappings between HIF-1 pathways and functions of TCM herbal medicines	354
9.1.1 Herbal medicines for increasing transcription and translation of HIF-1 α (facilitating lung Qi宣发肺气)	357
9.1.2 Herbal medicines for enhancing degradation of HIF-1 α (descending lung Qi 降气)	358
9.1.3 Herbal medicines for regulating transcription and translation of HIF-1 α (regulating Lung Qi 理肺气)	360

9.1.4 Herbal medicines for increasing HIF-1 α and attenuating HIF-1 α degradation (tonifying Lung Qi 补肺气).....	363
9.1.5 Herbal medicines for inhibiting TNF- α (cleansing Heat 清热), inhibiting IL-8 (moisturizing Dry 润燥), and decreasing VEGF	365
9.1.6 Panax Ginseng and Schisandra chinensis: their effects on HIF-1 α	370
9.2 The constipation due to lung Qi (HIF-1 α) deficiency.....	371
9.3 The constipation due to failure of lung Qi (HIF-1 α) facilitation (肺失宣发).....	373
9.4 The constipation due to failure of descending lung Qi (HIF-1 α) (肺不肃降).....	374
9.5 The constipation due to higher Heat	376
9.6 Conclusions.....	380
Chapter 10	381
TCM “Consumption” (消) and diabetes	
10.1 Physiological functions of TCM “Consumption” (消) in YEIC	381
10.2 FoxO1 and diabetes.....	387
10.3 “Consumptive-Thirsty” Syndrome (消渴症) in TCM	388
10.3.1 Cause of “Consumptive-Thirsty” Syndrome (消渴症)	389
10.3.2 Three stages of “Consumptive-Thirsty” Syndrome (消渴症)	391
10.3.3 TCM Strategy to treat Stage 1 “Consumptive-Thirsty” Syndrome.....	392
10.3.4 TCM Strategy to treat Stage 2 “Consumptive-Thirsty” Syndrome.....	393
10.3.5 TCM Strategy to treat Stage 3 “Consumptive-Thirsty” Syndrome.....	395
10.4 Comparison of views on diabetes between TCM and modern medicine	397
10.5 Summary	398
Chapter 11	400
“Central (中)” related Syndromes	
11.1 The TCM syndrome “Heat Central” (热中).....	400
11.2 The TCM Syndrome “Consumption Central (消中)”	407

11.2.1 “Consumption Central (消中)” syndrome is not “Middle Consumptive-Thirsty (中消)”	409
11.3 The TCM Syndrome “Cold Central (寒中)”	411
Chapter 12	416
Speculated Molecular Signaling Pathways	
12.1 Speculations of Evil Qi (LPS) on Five Zang organs	416
12.2 Speculation of Puzzling 惑 (acrophobia)	417
12.2.1 Quote from YEIC	417
12.2.2 Translation based on mappings	419
12.2.3 Speculation 1: LPS makes brain rotate	420
12.2.4 Speculation 2: LPS increases PTP more than Tyrosine phosphorylation	420
12.2.5 Speculation 3: LES enters from back of neck	421
12.3 Speculation of LPS entering	421
References	423
Index	605

PREFACE

Traditional Chinese Medicine (TCM) has been applied in China and east Asia Countries for thousands of years. TCM considers that there exist vital substances in human body to regulate the physiological processes, for example, Qi, Yang Qi, Yin Qi, etc. The TCM diagnosis and therapeutic strategies are all based on the functions and interrelationships of these vital substances. The fundamental doctrinal source for TCM is “Yellow Emperor’s Inner Canon” (YEIC, 黄帝内经 Huangdi Neijing). YEIC consists of two medical books, i.e., Su Wen Book (SW, 素问) and Ling Shu Book (LS, 灵枢). “Su Wen (素问)” means “Basic Questions”, and “Ling Shu (灵枢)” means “Miraculous Pivot”. Each book consists of 81 chapters. YEIC is the conversations between Yellow Emperor and Wise Men, and cover a broad range of topics, such as causes of various diseases, functions of meridians, treatment strategies, functions of TCM vital substances, etc.

In modern medicine, signaling molecules are the fundamental substances in human body, and the cascades of molecular signaling pathways trigger a series of physiological activities of human body. TCM and modern medicine use different terms but describe the same physiological functions in human body, and there should exist mappings between TCM and modern medicine. To find the mappings, we searched each TCM vital substance in YEIC, and listed their physiological functions and interrelationships; then searched the signaling molecule that could match these physiological functions. We identified 48 mappings between TCM vital substances and signaling molecules. For each mapping, the physiological functions are the same; the interrelationships among different TCM vital substances are also the same as the signaling pathways of corresponding molecules; the specific TCM herbal medicine have the same effect on this TCM vital substance and corresponding molecule. By applying these mappings, we analysed the TCM causes of arthritis, diabetes, and constipation and their corresponding TCM treatment strategies, and

demonstrated that the causes of diseases and treatment strategies between TCM and modern medicine are the same. These mappings also enable us to understand some TCM syndromes, including “Consumptive-Thirsty Syndrome (消渴症)”, “Heat Central Syndrome (热中症)”, etc.

These 48 TCM substances are TCM Essence (精), TCM Mind (神), TCM Ethereal Soul (魂), TCM Corporeal Soul (魄), TCM Ideation (意), TCM Will (志), TCM Thin Fluid (津), TCM Thick Fluid (液), Qi (气), Yang Qi (阳气), Yin Qi (阴气), Zong Qi (宗气), Glory Qi (荣气), Nutrient Qi (营气), Defending Qi (卫气), Heart Qi (心气), Spleen Qi (脾气), Lung Qi (肺气), Kidney Qi (肾气), Liver Qi (肝气), Cold Qi (寒气), Damp Qi (湿气), Dry Qi (燥气), Heat Qi (热气), Wind Qi (风气), Summerheat Qi (暑气), Clear Qi (清气), Turbid Qi (浊气), Righteous Qi (正气), Evil Qi (邪气), Genuine Qi (真气), Blood Qi (血气), Stomach Qi (胃气), Essence Qi (精气), Indulged Qi (淫气), Mind Qi (神气), Consumption (消), Central (中), Heart Yang (心阳), Heart Yin (心阴), Spleen Yang (脾阳), Spleen Yin (脾阴), Lung Yang (肺阳), Lung Yin (肺阴), Kidney Yang (肾阳), Kidney Yin (肾阴), Liver Yang (肝阳), Liver Yin (肝阴). Besides these 48 TCM substances, YEIC also mentioned other TCM substances, such as Yang Essence (Yang Jing, 阳精), Yin Essence (Yin Jing, 阴精), Shape Qi (形气), etc. However, the physiological functions of these TCM vital substances are not sufficient to identify their mappings.

As YEIC was written in ancient Chinese, we need dual translations to prepare this book, i.e., one from ancient Chinese to modern Chinese, and the other from modern Chinese to English. For ease reference and check, we keep the original ancient Chinese sentences in the text, and try our best to translate them into English as the original meaning, therefore, some translated English sentence may not form a complete sentence.

YEIC covers a broad range of topics. This book is only a small step for bridging TCM and modern medicines. We believe that the communication and mutual support between eastern and western medicines would provide a thorough understanding of human physiology and enable more effective treatment of abnormal or disease states.

Thanks to Professor Jian Lu for his encouragement. Thanks also go to Professor Weiwei Yan for her kind help to find out many Chinese articles and theses.

CHAPTER 1

INTRODUCTION

Traditional Chinese Medicine (TCM) has been applied in China and east Asia Countries for thousands of years. TCM considers that there exist vital substances in human body to regulate the physiological processes. The TCM diagnosis and therapeutic strategies are all based on the functions and interrelationship of these vital substances. The fundamental doctrinal source for TCM is “Yellow Emperor’s Inner Canon” (YEIC 黄帝内经, Huangdi Neijing). YEIC consists of two medical books, i.e., Su Wen Book (SW, 素问) and Ling Shu Book (LS, 灵枢); each book consists of 81 chapters. YEIC is the conversations between Yellow Emperor and Wise Men. During the conversations, they discussed the physiological functions of TCM vital substances, pathological reasons of various diseases, and treatment strategies. One of the conversations is as following:

Yellow Emperor asked: How to observe the victory of Six Qis? Qi Bo (Wise Man) answered: Observe it when it comes. More Clear Qi comes, it is the victory of Dry Qi, Wind Qi in liver gets evil, then induces liver disease (SW74, in Chapter 74, Su Wen Book of YEIC). 帝曰：…六氣之勝，何以候之。岐伯曰：乘其至也。清氣大來，燥之勝也，風木受邪，肝病生焉（素問-至真要大論）(Huang-Di 2005; Neijing 2021).

This conversation clearly demonstrated the pathological pathways of TCM vital substances. In modern medical science, molecular signaling is the most fundamental physiological processes. In this book, we analyzed the physiological functions and their interrelationships of the most often described TCM vital substances in YEIC, and compared them with physiological functions and pathways of signaling molecules. We tend to establish the mapping between these TCM vital substances and signaling molecules, i.e., we tend to establish the mapping between TCM and modern

medicines. According to the mappings, the TCM vital substances and signaling molecules have the same physiological functions and signaling pathways.

Yin, Yang and Qi are probably the most popular TCM words people ever heard. Before introducing the TCM vital substances and the mappings, we should first explain the meaning of Yin, Yang and Qi in TCM.

- Yin: In TCM, Yin has the cooling/astringent capacity. When used with Yang, Yin refers to the grouping of characteristics or things opposite to Yang. Depending on the context, Yin may also indicate Yin Qi, a TCM vital substance. When Yin is used together with other word, it refers to the Yin attribute, and usually the combined word represents a TCM vital substance, such as Yin Qi, Liver Yin, Heart Yin, Spleen Yin, Lung Yin, and Kidney Yin.
- Yang: In TCM, Yang has the warming/developing function. When used with Yin, Yang refers to the grouping of characteristics or things opposite to Yin. Depending on the context, Yang may also indicate Yang Qi, a TCM vital substance. When Yang is used together with other word, it refers to the Yang attribute, and usually the combined word represents a TCM vital substance, such as Yang Qi, Liver Yang, Heart Yang, Spleen Yang, Lung Yang, and Kidney Yang.
- Qi: In TCM, Qi has the actuation/regulation function. In YEIC, Qi may refer to the general term of Qi, and represent all kind of Qis. In most cases, Qi represents a TCM vital substance. When used together with other word, it refers to the Qi attribute, and usually the combined word represents a TCM vital substance. For example, Zong Qi, Glory Qi, Nutrient Qi, Defending Qi, Liver Qi, Heart Qi, Spleen Qi, Lung Qi, Kidney Qi, Cold Qi, Damp Qi, Dry Qi, Heat Qi, Wind Qi, Summerheat Qi, Yang Qi, Yin Qi, Clear Qi, Turbid Qi, Righteous Qi, Evil Qi, Stomach Qi, Genuine Qi, Blood Qi, Essence Qi, Indulged Qi, Mind Qi, etc.

In LS30, Chapter 30, Ling Shu Book: Yellow Emperor said, “I heard that human have Essence of Life (Jing, 精), Qi (气), TCM thin fluid (Jin, 津), TCM thick fluid (Ye, 液), Blood, and Pulse (脉); I thought they were a kind of Qi only; now I understand they are categorized into six aspects. (黄帝曰：余闻人有精、气、津、液、血、脉，余意以为一气耳，今乃辨为六名)”(Huang-Di 2005; Neijing 2021). This statement indicates that Essence

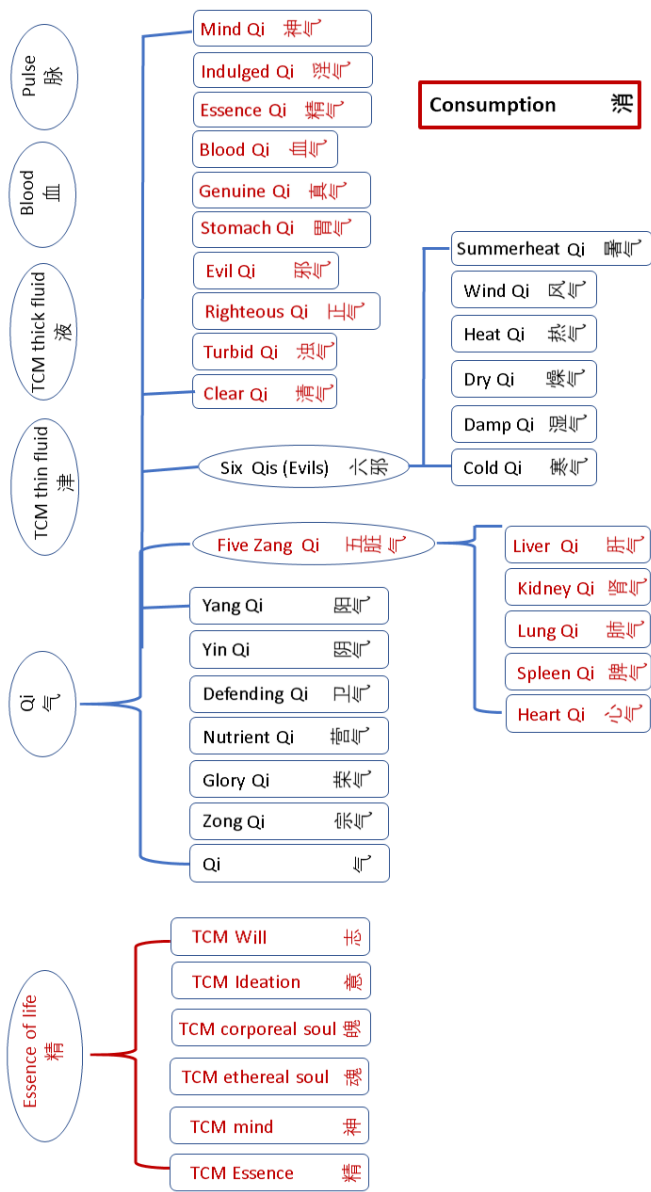


Fig. 1-1 TCM vital substances described in YEIC.

of Life (Jing, 精), Qi (气), TCM thin fluid (Jin, 津), TCM thick fluid (Ye, 液), Blood, and Pulse are important aspects of TCM. In this book, we do not introduce Pulse, but discuss the mappings of TCM vital substances that are most often discussed in YEIC. Fig. 1-1 shows the categories of TCM vital substances described in YEIC. We categorize these TCM vital substances into five parts, and introduce the mappings as following order.

1.1 TCM vital substances related to mood, TCM thin fluid, and TCM thick fluid

In TCM, the Essence of Life (Jing, 精) are vital substances relate to mood, including TCM Essence (Jing, 精), TCM Mind (Shen, 神), TCM Ethereal Soul (Hun, 魂), TCM Corporeal Soul (Po, 魄), TCM Ideation (Yi, 意), and TCM Will (Zhi, 志). TCM considers that these vital substances are responsible for mood regulation, and they are stored in five organs, respectively, as shown in Fig. 1-2. That is, heart containing TCM Mind (心藏神), lung containing TCM Corporeal Soul (肺藏魄), liver containing TCM Ethereal Soul (肝藏魂), spleen containing TCM Ideation (脾藏意), kidney containing TCM Will (肾藏志), and kidney containing TCM Essence (肾藏精) (Huang-Di 2005). TCM names heart, lung, spleen, kidney, and liver collectively as Five Zang-Organs. TCM considers there also exist vital substances related to these Five Zang-Organs and divides these vital substances into five groups according to their physiological functions.

TCM also considers that TCM thin fluid (Jin, 津) and TCM thick fluid (Ye, 液) are important aspects in human body.

The mappings are tabulated in table 1-1, and the details are discussed in Chapter 2.

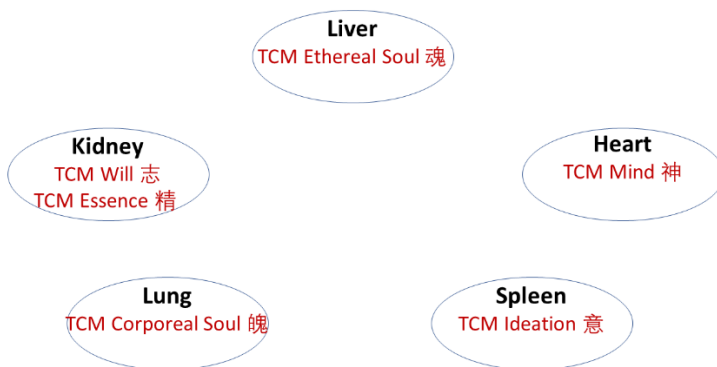


Fig.1-2 Heart containing TCM Mind (心藏神), lung containing TCM Corporeal Soul (肺藏魄), liver containing TCM Ethereal Soul (肝藏魂), spleen containing TCM Ideation (脾藏意), kidney containing TCM Will (肾藏志), and kidney containing TCM Essence (肾藏精).

Table 1-1 The mappings between TCM vital substances of mood and molecules

TCM vital substances	Corresponding molecule
TCM Essence (Jing, 精)	Tyrosine
TCM Mind (Shen, 神)	Melatonin
TCM Ethereal Soul (Hun, 魂)	Serotonin
TCM Corporeal Soul (Po, 魄)	Cysteine
TCM Ideation (Yi, 意)	Tryptophan
TCM Will (Zhi, 志)	Arginine
TCM Thin Fluid (Jin, 津)	Proteins
TCM Thick Fluid (Ye, 液)	Lipids

1.2 Qi, Zong Qi, Glory Qi, Nutrient Qi, Defending Qi, Yin Qi and Yang Qi

In YEIC, the general term of Qi may indicate all kinds of Qis; when discussed a specific physiological function, the Qi may represent the TCM

substance, Qi. Qi is the TCM substance most often discussed in YEIC. Zong Qi (宗气), Glory Qi (荣气), Nutrient Qi (营气), Defending Qi (卫气), Yin Qi (阴气), and Yang Qi (阳气) are also TCM vital substances.

The mappings are tabulated in Table 1-2, and the details are discussed in Chapter 3.

Table 1-2 The mappings between TCM Qis and molecules

TCM Qis	Corresponding molecule
Qi (气)	Sodium
Zong Qi (宗气)	Dopamine
Nutrient Qi (营气)	cyclic Adenosine Monophosphate (cAMP)
Glory Qi (荣气)	Adenosine Triphosphate (ATP)
Defending Qi (卫气)	Chloride
Yin Qi	Potassium
Yang Qi	Calcium

1.3 Yin, Yang, Qi in Five Zang-Organs (Five Groups, 五行)

As mentioned in Section 1.1, YEIC named heart, spleen, lung, kidney and liver as Five Zang-Organs. TCM categorized the vital substances related to Five Zang-Organs into five groups according to their physiological functions, i.e., heart group, spleen group, lung group, kidney group and liver group, the so-called “Five Groups (五行).” In each group, TCM further divided the vital substances into specific Yang, Yin, and Qi. As shown in Fig. 1-3, heart group consists of “Heart Yin, Heart Yang, and Heart Qi”, spleen group consists of “Spleen Yin, Spleen Yang, and Spleen Qi”, lung group consists of “Lung Yin, Lung Yang, and Lung Qi”, kidney group consists of “Kidney Yin, Kidney Yang, and Kidney Qi”, and liver group consists of “Liver Yin, Liver Yang, and Liver Qi”.

The mappings are tabulated in Table 1-3, and the details are discussed in Chapter 4.

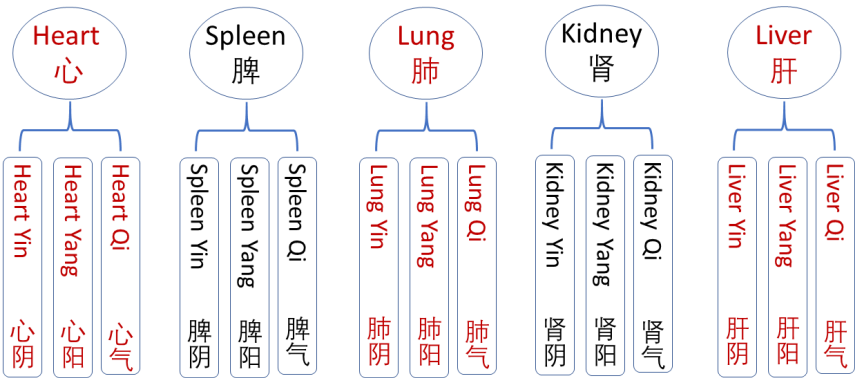


Fig. 1-3 TCM Yin-Yang-Qi in Five Groups

Table 1-3 The Mappings between TCM Five Groups and signaling molecules

	Yang 阳	Yin 阴	Qi 气
Heart group 心	Insulin Growth Factor (IGF)	Angiotensin	Magnesium (Mg)
Spleen group 脾	Atrial Natriuretic Peptide (ANP)	Aldosterone, Retinoic Acid	Ghrelin
Lung group 肺	Vascular Endothelial Growth Factor (VEGF) Fibroblast Growth Factor 7 (FGF7)	Ascorbic Acid	Hypoxia-Inducible Factor (HIF)
Kidney group 肾	Calcitonin Parathyroid hormone-related protein (PTHrP)	Wnt	Nitric Oxide (NO)
Liver group 肝	Hepatocyte Growth Factor (HGF) Erythropoietin (EPO)	Superoxide Dismutase (SOD) Renin	Glutathione (GSH)

1.4 Six Qis (Six Evils, 六邪): TCM vital substances related to environment

YEIC named the TCM vital substances related to environment as Six Qis (Six Evils 六邪), such as “Wind Qi” (风), “Cold Qi (寒),”, “Damp Qi (湿)”, “Heat (fire) Qi (热/火)”, “Summerheat Qi (暑)”, and “Dry Qi (燥)”. In ordinary conditions, these Six Qis regulate the human body to adapt to the variation of environment. When these Six Qis change abnormally, they would cause illness and various clinical manifestations, and they are called “Six Evils”, as shown in Fig. 1-4. These “Six Evils” can be induced by external factors, i.e., “Wind Evil” can be induced by wind, “Cold Evil” can be induced by cold environment, “Damp Evil” can be induced by humid environment, “Heat (Fire) Evil” can be induced by heat, “Summerheat Evil” can be induced by summer heat stress, and “Dry Evil” can be induced by dry environment. These TCM “Six Evils” may cause pain, fever and inflammation, and TCM has identified various herbal medicines to treat these “Six Evils”, respectively (赵.C. Zhao and Li 2000). Moreover, TCM considers that, among these Six Evils, “Wind Evil” affects the liver organ, “Summerheat Evil” affects the heart organ, “Damp Evil” affects the spleen organ, “Dry Evil” affects the lung organ, and “Cold Evil” affects the kidney organ, as shown in Fig. 1-5.

The mappings are tabulated in Table 1-4, and the details are discussed in Chapter 5.

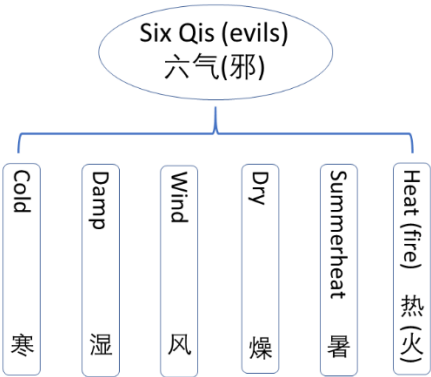


Fig. 1-4 TCM “Six Evils”.

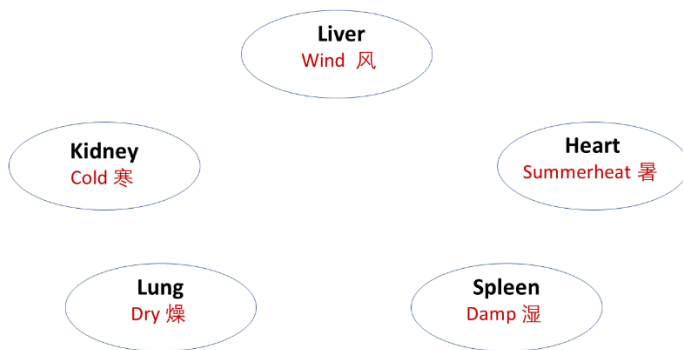


Fig. 1-5 Wind Evil affects liver, Summerheat Evil affects heart, Damp Evil affects spleen, Dry Evil affects lung, and Cold Evil affects kidney.

Table 1-4 The mappings between TCM “Six Qis (Evils)” and molecules

TCM “Six Qis” (Six evils)	Corresponding cytokine
Cold Qi (cold evil 寒)	Interleukin-1 (IL-1)
Damp Qi (damp evil 湿)	Interleukin-6 (IL-6)
Wind Qi (wind evil 风)	Nuclear Factor-κB (NF-κB)
Heat (fire) Qi (heat evil 热)	Tumor Necrosis Factor alpha (TNF-α)
Dry Qi (dry evil 燥)	Interleukin-8 (IL-8)
Summerheat Qi (summerheat evil 暑)	Cyclooxygenase-2 (COX-2)

1.5 Clear Qi, Turbid Qi, Righteous Qi, Evil Qi, Stomach Qi, Genuine Qi, Blood Qi, Essence Qi, Indulged Qi, and Mind Qi

In the conversation of YEIC, it also described the physiological functions and interrelationships of Clear Qi (清气), Turbid Qi (浊气), Righteous Qi (正气), Evil Qi (邪气), Stomach Qi (胃气), Genuine Qi (真气), Blood Qi (血气), Essence Qi (精气), Indulged Qi (淫气), and Mind Qi (神气).

The mappings are tabulated in Table 1-5, and the details are discussed in Chapter 6.

Table 1-5 The mappings of other Qis, Consumption and Central

TCM vital substance	Molecule
Clear Qi (清气)	Toll-like receptor 4 (TLR4)
Turbid Qi (浊气)	Leptin
Righteous Qi (正气)	Immunoglobulin G (IgG)
Evil Qi (邪气)	Lipopolysaccharide (LPS)
Stomach Qi (胃气)	Amylase
Genuine Qi (真气)	Phosphorus
Blood Qi (血气)	Iron
Essence Qi (精气)	Zinc
Indulged Qi (淫气)	Gonadotropin-releasing hormone (GnRH)
Mind Qi (神气)	Thyroid Hormone (TH)
Consumption (消)	Forkhead Box O1 (FoxO1)
Central (中)	Aldosterone

1.6 Consumption (消) and Central (中)

In YEIC, the “Consumption (消)” is a TCM vital substance. The “Consumption” may represent various syndromes, such as “Wind Consumption 風消” syndrome, “Lung Consumption 肺消” syndrome, “Consumption Central 消中” syndrome, and “Consumptive-Thirsty” Syndrome (消渴症). Where “Consumptive-Thirsty” (消渴) corresponds to diabetes. The mapping is tabulated in Table 1-5, and the details are discussed in Chapter 10.

The “Central” is also a TCM vital substance. The mapping is tabulated in Table 1-5, and the details are discussed in Section 4.2.5 and Chapter 11.

1.7 The methods to identify the mapping between signaling molecule and TCM vital substance

In physiological reality, molecular signaling is the most fundamental physiological processes. Signaling pathway is a series of chemical reactions that occur within a biological cell when initiated by a stimulus. This stimulus, known as a first messenger, acts on a receptor that is transduced to the cell interior through second messengers which amplify the signal and transfer it to effector molecules, causing the cell to respond to the initial stimulus. Most biochemical cascades are series of events, in which one event triggers the next, in a linear fashion. At each step of the signaling cascade, various controlling factors are involved to regulate cellular actions, in order to respond effectively to cues about their changing internal and external environments (Gomperts et al. 2002). The transduction pathways of signaling molecules are important to understanding how signaling molecules regulate the physiological function and in predicting the pathological development which is important to therapeutic strategy. However, despite the documented importance of signaling molecules to human life, we still lack thorough knowledge of transduction pathways of signaling molecules.

In YEIC, the TCM vital substances are usually discussed in two conditions, i.e., the “static” and the “dynamic” conditions. The examples of these two conditions are as following:

- “Static” Condition: The physiological functions of TCM vital substances do not change with time or the TCM vital substances are not specified at a certain location. For example, in Chapter 01, Su Wen Book: At age of 48, Yang Qi exhausts, the skin becomes withered and dark, hairs become white (素問-上古天真論: 六八, 陽氣衰竭於上, 面焦, 髮鬢頒白). This statement described the Static Effect of Yang Qi. There have been abundant experimental and clinical references for the “Static” Conditions.
- “Dynamic” Condition: TCM vital substances change with time and location. For example, in Chapter 29, Su Wen Book: Yang Qi travels up from hands to head, then travels down to feet (素問-太陰陽明論: 陽氣從手上行至頭, 而下行至足). This statement described the “dynamic” state of Yang Qi. However, the current techniques cannot measure this kind of “dynamic” process yet.

TCM and modern medicine should describe the same physiological processes in the human body but using different terminology. There must be some links between the TCM vital substances and the signaling molecules. In this book, we have established the mapping between these TCM vital substances and the signaling molecules. To identify each mapping, we have applied the following procedures.

1. In YEIC, the functions of TCM vital substances are discussed in the conversations in various chapters. For each TCM vital substance, we summarize all the “static” conditions and take them as the constraint conditions to search for the corresponding molecule that could match these “static” conditions. These constraint conditions include not only the physiological functions but also the interrelationships among different TCM vital substances.
2. If the corresponding molecule satisfies the constraint conditions, the identified corresponding molecule should have the same physiological functions as those of the TCM vital substance. Moreover, the interrelationships among the TCM vital substances should be consistent with the signaling pathways of the corresponding molecules as well. This indicates that the pathways of the TCM vital substances are the same as the pathways of the signaling molecules.
3. TCM uses herbal medicine to regulate each vital substance. We have validated each mapping by comparing the effect of the same herbal medicine on the TCM vital substance and the corresponding molecule, and the effects are the same.

YEIC also discussed the pathways of the TCM vital substances. As an example, by applying the mappings, we have analyzed some of the TCM pathways, and found that the TCM pathways are consistent with the molecular signaling pathways. Moreover, we have applied the mappings to analyze the molecular mechanism of constipation, arthritis and diabetes, and shown that the TCM causes of these diseases and TCM therapeutic strategies are the same as those of modern medicines. Further, these mappings also enable us to understand some TCM syndromes, including “Consumptive-Thirsty Syndrome (消渴症)”, “Heat Central Syndrome (热中症)”, etc.

The mappings for 48 TCM vital substances are shown in Fig. 1-6. We explain the mappings in detail in the following chapters.

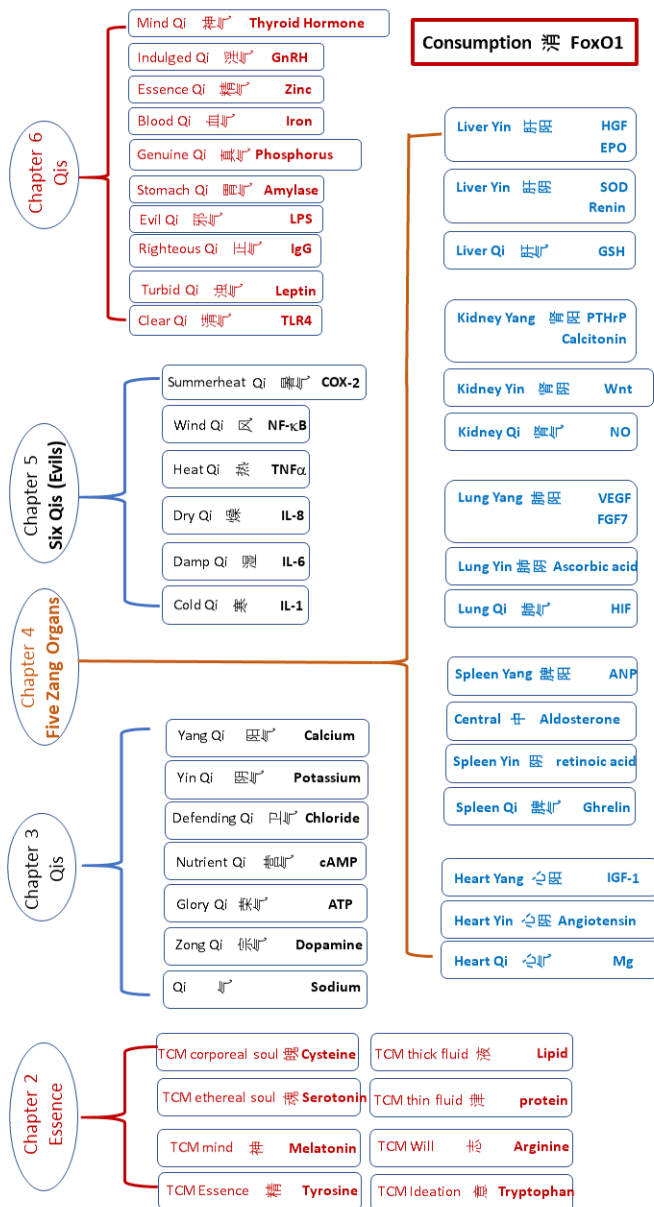


Fig. 1-6 Mappings between molecules and TCM vital substances.

CHAPTER 2

THE MAPPINGS OF TCM VITAL SUBSTANCES RELATED TO MOOD, TCM THIN FLUID, AND TCM THICK FLUID

The TCM vital substances relate to mood are TCM Essence (Jing, 精), TCM Mind (Shen, 神), TCM Ethereal Soul (Hun, 魂), TCM Corporeal Soul (Po, 魄), TCM Ideation (Yi, 意), and TCM Will (Zhi, 志). TCM also considers that TCM thin fluid (Jin, 津) and TCM thick fluid (Ye, 液) are important aspects in the human body. To establish the mapping between the TCM vital substance and the molecule, for each vital substance, we summarize its physiological functions and compare with those of corresponding molecule. For ease reference, we list the chapter number and the original statement in ancient Chinese as well.

2.1 TCM Essence (Jing, 精) corresponds to tyrosine

2.1.1 Comparison between TCM Essence and Tyrosine

The physiological functions of TCM Essence described in YEIC are tabulated and compared with tyrosine in Table 2-1, where SW indicates Su Wen Book (素问), LS indicates Ling Shu Book (灵枢), and NJ indicates Yellow Emperor Nan Jing (黄帝难经).