

Review

Integrative Nutritional Therapy in Canine Cognitive Dysfunction

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ABSTRACT

Canine cognitive dysfunction (CCD) is a progressive neurodegenerative condition that presents many of the behavioral and pathological changes seen in human Alzheimer's dementia. It typically causes significant long-term suffering in both the patient and the caretaker. In patients with CCD and Alzheimer's disease (AD), conventional dietary therapy has been helpful in preventing and slowing cognitive decline. Chinese medical food therapy to balance the body may also be beneficial in these patients. This paper will discuss conventional dietary intervention in dogs, along with traditional Chinese food therapy (CFT) according to pattern diagnosis in CCD. It is possible that a combination of syndrome differentiation in CFT and conventional nutritional therapy may help improve cognition and quality of life in patients with CCD.

Keywords: Alzheimer's disease, canine cognitive dysfunction, Chinese food therapy, cognitive dysfunction syndrome, diet, nutritional therapy, traditional Chinese veterinary medicine

ABBREVIATIONS

Aβ: Amyloid-beta; **AD:** Alzheimer's disease; **CCD:** Canine cognitive dysfunction; **ccSDAT:** Canine counterpart of senile dementia of the Alzheimer's type; **CHM:** Chinese herbal medicine; **C.E.:** Common Era - secular equivalent of A.D. (anno Domini); **CFT:** Chinese food therapy; **DHA:** Docosahexaenoic acid; **GABA:** Gamma-aminobutyric acid; **MCTs:** Medium-chain triglycerides; **SAME:** S-adenosyl-L-methionine; **TCM:** Traditional Chinese medicine; **TCVM:** Traditional Chinese veterinary medicine; **VAS:** visual analogue scale

Improvements in medicine and nutrition have led to an increased life span of canines.¹ As a result, there is an increased number of aged dogs with neurodegenerative disease. A syndrome, involving cognitive changes that are not associated with normal aging, occurs in dogs and shares many features of human dementia of the Alzheimer's type.² In the canine, the cognitive and pathological changes begin to develop in middle age and proceed as the dog ages, similar to the course of Alzheimer's disease (AD).³ The syndrome is known as canine cognitive dysfunction (CCD), canine cognitive dysfunction syndrome, or canine counterpart of senile dementia of the Alzheimer's type (ccSDAT).^{2,4,5} The original reports of this neurodegenerative disorder were published by Ruehl and colleagues in the mid-1990s.⁶ In more recent research, evidence is accumulating that a similar condition may occur in cats.^{6,7}

The problem of canine cognitive dysfunction is significant, since 28% of 11- to 12-year-old dogs and 68% of 15- to 16-year-old dogs show one or more signs of the disorder.⁸ It is also underdiagnosed in up to 85% of potentially affected companion dogs, causing unnecessary suffering.⁹ In the literature, there is evidence that conventional nutritional therapy may be beneficial in improving cognition in canines.¹⁰ Food therapy based on *Bian Zheng* or pattern diagnosis is one of the branches of traditional Chinese veterinary medicine (TCVM) that may be added to offer an integrated approach in the treatment of this disease.¹¹

PATHOLOGY

In conventional medicine, CCD includes the accumulation of amyloid-beta (Aβ) in the brain and cerebral vascular disease.^{1,10,12} It is suggested that these processes are interconnected, with one leading to progression of the other.¹⁰ According to Dewey et al., a combination of 4 pathological processes interact in the development of cognitive decline in both humans and dogs: 1) cerebral vascular hypoperfusion and associated impairment of mitochondria; 2) accumulation of toxic proteins, primarily Aβ; 3) oxidative injury in the brain; and 4) abnormal microglial and astrocyte activity that creates an environment of inflammation in the brain.¹³ In affected dogs, loss of serotonergic, noradrenergic, and cholinergic neurons may be seen, along with cerebral atrophy and reduced oxidative glucose metabolism.^{10,14-19} A decreased concentration of vitamin E has also been found in the brain tissue of canines with ccSDAT.⁵ It is becoming more evident that humans, dogs and cats show similarities in clinical progression and pathology associated with cognitive impairment.²⁰

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CLINICAL SIGNS

The neurodegeneration in CCD leads to a gradual decline in cognitive function, evidenced by certain clinical signs. These include disorientation, poor social interaction, sleeping during the day/restlessness at night, house soiling, changes in activity, anxiety and loss of learned behavior/memory, represented by the acronym DISHAAL.²¹ The decline has been reported by owners as changes in greeting behavior, staring into space or becoming lost in corners, loss of housetraining, pacing or vocalizing at night or newly developed behavior problems.²²

Studies have linked signs of cognitive dysfunction to A β deposition in certain regions in the canine brain.²³ The accumulation of A β in the frontal cortex along with frontal lobe atrophy is associated with loss of executive function.²⁴ In addition, maintenance behavior, such as eating, drinking and searching are affected.²³ In dogs with elevated prefrontal cortex A β , reversal learning deficits are seen.⁶ The hippocampus is also susceptible to deposition of A β .²⁵ In hippocampal deficits, classic CCD signs are seen, with initial preservation of older memories, similar to early and middle stages of Alzheimer's disease.

In CCD, novel signs of fear, phobias and anxiety are commonly observed and may parallel the finding of agitation and anxiety in Alzheimer's dementia, where 20-60% of patients experience such issues.^{20,26} Anxiety may be related to disturbances in the sleep-wake cycle seen in humans and dogs with cognitive impairment. Studies report that Alzheimer's patients with nighttime disturbances show higher levels of anxiety.²⁶

DIAGNOSIS

In CCD, the most noted clinical indications are alternations in daily routine and behavior.² As such, CCD is commonly diagnosed based on owner questionnaires and rating scales focusing on clinical signs. These problems are similar to those seen in the stages of Alzheimer's dementia.²⁷ A clinically relevant screening and assessment tool, the Canine Cognitive Dysfunction Rating Scale is effective in differentiating clinical signs of CCD from normal aging, with a diagnostic accuracy of 99.3%.⁹ As an option, the Canine Dementia Scale can be used to identify mild and moderate cognitive impairment, and severe cognitive dysfunction.^{28,29} In the assessment, diseases with similar clinical signs, such as primary behavioral conditions or other cerebral diseases need to be considered.^{10,26}

It may also be helpful to include neuropsychological tests and biomarker testing in differentiating dogs with CCD from normally aging dogs. The Vienna Canine Cognitive Battery provides a useful clinical tool to examine general, social, and physical cognition in pet dogs as well as interaction with humans.³⁰ A biomarker for early CCD detection in aging dogs is serum level of the neurofilament light chain, a central biomarker for neurodegeneration.²⁹

CONVENTIONAL TREATMENT

In CCD, conventional medications may help slow deterioration and/or improve clinical signs. Selegiline, a monoamine oxidase inhibitor with antioxidant properties, is reported to enhance dopamine and other catecholamines in the cortex, including the hippocampus.^{20,31} Clinical signs associated with CCD have been alleviated with its use in both non-clinical and open-label field studies.^{20,31,32} Side effects, however, can limit its usefulness and include anorexia, diarrhea, hindlimb paresis, ataxia and vestibular signs.^{31,33} It may also interact with opioids, α -2 agonists, other monoamine oxidase inhibitors and medications that enhance serotonin transmission.^{20,33} Propentofylline, a xanthine derivative, increases the molecular signal adenosine and is helpful in suppressing the release of microglial inflammatory mediators and free radicals.^{34,35} It is used in treating dullness, lethargy and depression in CCD.^{20,36} The minimal data on side effects includes increased body weight and decreased exploratory behavior in an animal model.³⁷ Nicergoline, an α -adrenergic antagonist, improves cerebral blood flow and metabolism, but there are limited clinical studies on its efficacy and safety in canines.^{38,39} In a randomized experimental trial comparing the effects of propentofylline, nicergoline and adrafinil, only adrafinil, a noradrenergic agonist, showed efficacy in enhancing behavior in beagle dogs in open-field and home cage testing.⁴⁰ Adrafinil has also shown some efficacy in improving learning in dogs, but in a placebo-controlled crossover study, it was shown to significantly impair memory.⁴¹ It is not generally seen to cause stereotypical side effects common to other stimulants.^{40,42} Other therapies to be considered include gabapentin, N-acetyl-D-mannosamine and possibly a drug or natural therapy to improve cholinergic transmission.^{20,43,44}

Complementary conventional therapy may also be considered. As an example, benzodiazepines, such as lorazepam, may be helpful to treat disturbances in sleep-wake cycle and anxiety due to the sedative and anxiolytic effects.^{20,36,45} They are also helpful to treat fears and phobias.^{33,36} In dogs, there is a concern for side effects, such as lethargy and idiosyncratic increase in activity or vocalization.^{33,45}

CONVENTIONAL NUTRITIONAL THERAPY

Modified Diets

In several studies, it is suggested that nutrition may have a beneficial effect in improving clinical signs and attenuating cognitive decline in CCD.⁴⁶ In a study assessing risk factors, it was demonstrated that dogs given a high-quality commercial diet intended for breed, life stage or health status were 2.8 times less likely to develop CCD than dogs given a general low-quality commercial food or table scraps.^{46,47} Special diets, including supplements, designed to improve cognition may be helpful to include in a holistic treatment (Box 1).

Diets supplemented with the cellular antioxidants, vitamins C and E, mitochondrial cofactors (D,L- α -lipoic acid, L-carnitine), and a selection of fruits/vegetables rich in carotenoids and flavonoids may be used to alleviate cerebral neurodegeneration and improve cognition.^{30,48,49} It is reported that carotenoids and flavonoids have antioxidant properties and may also act as mitochondrial cofactors.¹³ In a longitudinal study, a diet containing these supplements was shown to lessen protein oxidation and A β in the brain in aged dogs.^{48,49} This diet was also seen to significantly improve performance in oddity discrimination learning and size discrimination reversal learning in aged dogs as compared with a control diet.^{50,51} Of interest, enhanced effects were seen in dogs that also received behavioral enrichment, consisting of social interaction, play, walking and cognitive testing.^{20,48,49,51} In this study, canines given the supplemented diet showed an increase in serum vitamin E compared to control after 6 months.⁵⁰ In another study assessing the antioxidant diet, an improvement in performance on a landmark discrimination task was seen to correlate with serum vitamin E level in aged beagles.^{52,53} The senior diet^a based on antioxidants and mitochondrial cofactors may be helpful to lessen cognitive decline, especially if started at an early age, around 6 years.^{20,30,54}

A nutrient blend of antioxidants, B vitamins, fish oil and L-arginine may also help to prevent cognitive decline. In a non-clinical canine study, the diet significantly improved performance in learning tasks and reversal learning as compared to control.⁵⁵ The findings also showed a significantly higher plasma level of certain protective nutrients in the diet, including L-arginine, α -tocopherol, docosahexaenoic acid (DHA) and eicosapentaenoic acid. It is reported that L-arginine is a precursor of nitric oxide, a molecule that aids in memory formation.^{55,56} It was concluded that long-term supplementation with these ingredients may help to maintain or enhance cognition in aged dogs.

In patients with CCD, dietary therapy has been shown to be helpful in improving clinical signs. In a double-blind placebo controlled clinical trial, a diet containing antioxidants, B vitamins, omega-3 fatty acids and 6.5% medium-chain triglyceride vegetable oil was effective in significantly improving all 6 categories of clinical signs, including disorientation, altered social interaction and loss of house training, after 90 days as compared with baseline in dogs with CCD.⁵⁷ The ingredients in this diet target some of the known risk factors associated with AD in humans, such as chronic oxidative stress, DHA deficiency and reduced cerebral glucose metabolism.⁵⁷ As a similar pathology is seen in dogs, a veterinary diet containing these ingredients^b may help slow cognitive decline in patients suffering with CCD.^{45,46} Additionally, a multicenter clinical trial assessed a diet enriched with carnitine, lipoic acid, long-chain omega-3 polyunsaturated fatty acids, vegetable-based carotenoids and vitamins C and E in dogs that were losing cognitive abilities.⁵⁸ This senior diet^a showed significant improvements in behavior in supplemented dogs as compared with control.^{10,53,58,59}

Medium-chain triglycerides (MCTs) may be helpful to provide an alternate energy source for the brain.²⁰ In a non-clinical study, aged dogs given a 5.5% MCT supplemented diet^c showed significantly improved performance in various cognitive tasks as compared with controls.⁶⁰ The dietary supplementation significantly improved visuospatial ability, attention, learning and reversal learning, with the more difficult tasks showing a more significant effect. In this study, dogs given the supplemented diet were also seen to have increased serum ketone levels, as MCTs are converted to ketones in the body. There were no adverse effects on the health of the aged dogs, and safety was confirmed in an independent study. It is suggested that MCT supplementation can improve cognition in aging dogs by providing an alternate source of energy for the brain in the form of ketones, without side effects. In the literature, it is reported that an MCT supplemented diet may also help improve cognition by increasing levels of n-3 polyunsaturated fatty acids in the brain, improving energy metabolism in mitochondria and lessening levels of the precursor of A β in the parietal cortex in aged dogs.^{20,61,62} A diet containing botanic oils as a source of MCTs at 5.5%^{c,d}, therefore, may be supportive in treating patients with CCD.^{20,46,54}

Nutritional Supplements

In CCD, nutritional supplements may also be supportive. S-adenosyl-L-methionine (SAME), a molecule formed naturally in the body and found in all living cells, may be used as a supplement to help in the synthesis of neurotransmitters as well as glutathione, an endogenous antioxidant (Box 1).²⁰ In a double-blind placebo-controlled trial, SAME as a dietary supplement resulted in a greater improvement in activity and awareness in dogs with cognitive dysfunction after 8 weeks.⁶³ In the mental impairment score, a significantly greater proportion of patients responded favorably to SAME as compared with placebo ($p = 0.0228$). It was concluded that SAME is safe and effective in improving signs of cognitive decline in aged dogs. In non-clinical controlled studies, SAME has been shown to improve executive function in aged dogs as well as in the less cognitively impaired aged cats.^{64,65} These findings support the use of SAME in cognitive decline in aged dogs and cats, especially in early stages of CCD. As SAME therapy may increase serotonin levels in the brain, it is used with caution when combining with serotonin-enhancing drugs.²⁰

A natural membrane phospholipid, phosphatidylserine, may be helpful to protect neurons and enhance acetylcholine release and neuron growth.⁶⁶⁻⁶⁸ In a double-blind placebo-controlled trial, a supplement containing phosphatidylserine, antioxidants and omega-3 fatty acids^c was effective in improving level of disorientation, change in interaction and loss of housetraining in canines with cognitive dysfunction within 21 days of treatment.⁶⁶ The overall assessment by investigators showed a significant difference in age-related behavior and quality of life favoring nutritional therapy ($p = 0.008$ and $p = 0.004$, respectively). These data support the clinical practice of

nutrient supplementation in patients with CCD. It is reported that a supplement containing phosphatidylserine, Ginkgo biloba, vitamin E and pyridoxine^f may also benefit cognition in canines.⁶⁹ In a blinded crossover study in aged dogs, performance accuracy in a delayed-non-matching-to-position (DNMP) memory task was significantly improved in treated dogs as compared with control. The effect was maintained for 70 days post-treatment, suggesting a long-term benefit in improving memory. In an open-label pilot study, use of this supplement also showed a significant improvement in clinical signs in dogs with CCD.⁶⁷ The herb Ginkgo biloba is reported to stimulate acetylcholine release and lessen oxidative stress and A β in the brain.^{46,69,70} Pyridoxine (vitamin B6) is helpful, as it is a cofactor in neurotransmitter synthesis.^{46,69}

A calcium binding protein, apoaquorin, acquired from the jellyfish (*Aequorea victoria*), may provide some neuroprotection.⁷¹ It is reported that this protein helps protect hippocampal neurons from excitotoxicity and cell injury in ischemia.^{10,71,72} Interestingly, a decrease in endogenous calcium binding proteins is noted in aging and Alzheimer's disease.⁷¹ In a non-clinical study, apoaquorin therapy was seen to improve object discrimination learning and selective attention as compared with selegiline and placebo controls in aged beagle dogs.⁷² It has also shown cognitive benefits in aging humans with memory impairment.⁷³ In non-clinical laboratory studies, no adverse effects were noted.^{71,72}

Additional ingredients mentioned in the literature that may help patients with CCD include resveratrol and curcumin.¹⁰ A component of resveratrol, miyabenol C, isolated from the stems and leaves of the small-leaf grape, may lessen A β in the brain.⁷⁴ Curcumin, a phenolic compound found in the rhizome of the turmeric plant *Jiang Huang* (Curcuma), may pass through the blood-brain barrier and bind to A β in the brain, inhibiting its aggregation and fibril formation.^{75,76} In animal models, resveratrol and curcumin have been shown to improve memory.^{77,78}

Nutritional Supplements with Calming Effects

Natural conventional therapies may also be useful in alleviating signs of anxiety and sleep-wake disturbances in CCD (Box 1).²⁰ Alpha-casozepine, a decapeptide derived from α S1-casein in milk, has been studied for efficacy in treating anxiety in cats and dogs.^{36,45} It is structurally similar to gamma-aminobutyric acid (GABA), with an affinity for benzodiazepine receptors.^{45,79} In a multi-center randomized controlled trial from Europe, alpha-casozepine^e was seen to significantly decrease the emotional disorders evaluation in dogs (EDED), a scale measuring phobias and anxiety-related disorders.⁷⁹ There was, however, no significant difference as compared with selegiline as a control. It was concluded that alpha-casozepine is safe and effective in the management of anxiety in dogs. In a similar multi-center study in cats, alpha-casozepine showed a statistically significant difference as compared with placebo in management of social phobias, such as fear of strangers and contact with familiars.⁸⁰

L-theanine has also been shown to decrease anxiety in companion animals. Studies suggest that L-theanine may increase central serotonin, dopamine, and GABA levels and have neuroprotective effects.^{81,82} In an open-label trial, therapy with an L-theanine-based supplement^h was seen to significantly decrease global anxiety and diminish specific behaviors, such as panting and pacing, in storm-sensitive dogs.⁸³ In a non-clinical study in dogs, this supplement was shown to be effective in increasing human interaction and approach as compared with placebo.⁸⁴ L-theanine has also demonstrated efficacy in helping to manage stress-related behavior in cats.⁸¹

A combination of souroubea and platanus may be helpful in lessening anxiety levels in dogs as well. The plant extracts contain pentacyclic triterpenes that are known to have anxiolytic, anti-depressant and anti-inflammatory effects.⁸⁵ In vivo studies indicate that the extract of Souroubea sympetala acts at the GABA_A-benzodiazepine receptor to elicit its anxiolytic effect.⁸⁶ In a non-clinical study in beagle dogs, a dietary supplement containing a mixture of Souroubea spp. vine and Platanus spp. barkⁱ was significantly more effective than placebo in decreasing anxiety response to intermittent thunder sounds and serum cortisol levels in a dose-dependent manner.^{85,87,88} Other natural products that may help with anxiety and sleep disturbance in CCD include melatonin, valerian root (*Valeriana officinalis*) or a multi-ingredient veterinary product^j containing L-theanine, whey protein, Magnolia officinalis and Phellodendron amurense.^{10,20,36,54,89,90} Certain platanus, magnolia and phellodendron species have been used for centuries as Chinese herbal medicines (CHM).⁹¹⁻⁹³

Box 1

Conventional Diets and Supplements Beneficial for Cognitive Decline

Modified Diets^{45,46,48-55,57,58,60}

Cellular antioxidants vitamins C and E, mitochondrial cofactors (D,L- α -lipoic acid, L-carnitine), fruits/veg^a
Containing antioxidants, B vitamins, fish oil and L-arginine
Containing antioxidants, B vitamins, omega-3 fatty acids, 6.5% medium-chain triglyceride (MCT) vegetable oil^b
Supplemented with 5.5% MCT^{c,d}

Nutritional Supplements^{10,63,64,66,67,69,71,72}

S-adenosyl-L-methionine (SAME)
Combination of phosphatidylserine, antioxidants and omega-3 fatty acids^e
Combination of phosphatidylserine, Ginkgo biloba, vitamin E and pyridoxine^f
Calcium binding protein, apoaquorin
Resveratrol
Curcumin

Nutritional Supplements with Calming Effects^{10,54,79,83,84,87-90}

Alpha-casozepine^e
L-theanine-based supplement^h
Souroubea spp. vine and Platanus spp. barkⁱ
Melatonin
Valerian root (*Valeriana officinalis*)
L-theanine, whey protein, Magnolia officinalis and Phellodendron amurense^j

HISTORY OF TRADITIONAL CHINESE MEDICINE TREATMENT FOR COGNITIVE DECLINE

In traditional Chinese medicine (TCM), the treatment of cognitive decline is referenced in the classic literature. In the earliest Chinese materia medica, *Shen Nong Ben Cao Jing*, compiled in the later Han Dynasty circa 200 C.E. (Common Era), herbs such as *Chang Pu* (Acorus), *Long Dan* (Gentiana), *Chi Zhi* (Ganoderma Rubra) and *Yuan Zhi* (Polygala), were recorded as helpful to improve memory loss.⁹⁴ In the *Jing Yue Quan Shu* (Collected Works of Zhang Jing Yue, 1624 C.E.), the pathogenesis of dementia is described as a collapse of *Yuan Qi* and Phlegm obstructing the Meridians and orifices.⁹⁵⁻⁹⁷ This work contains the earliest known description of a CHM as treatment for dementia: *Qi Fu Yin*, a formula containing *Ren Shen* (Ginseng), *Shu Di Huang* (Rehmannia), *Dang Gui* (Angelica), *Da Zao* (Jujube), *Gan Cao* (Glycyrrhiza) and *Yuan Zhi* (Polygala).⁹⁵ *Qi Fu Yin* is still in use for Alzheimer's disease. In the *Bian Zheng Lu* (Collected Works of Shiduo Chen, 1690 C.E.), the formula, *Su Xin Tang*, is suggested based on treatment principles for dementia: tonifying the Spleen and Stomach, resolving Phlegm and clearing the orifices of the Heart.^{95,97-99} The recipe was created using *Ren Shen* (Ginseng), *Fu Ling* (Poria), *Ban Xia* (Pinellia), *Chai Hu* (Bupleurum), *Huang Lian* (Coptis), *Wu Zhu Yu* (Evodia), *Zhi Zi* (Gardenia), *Fu Zi* (Aconite), *Dang Gui* (Angelica), *Bai Shao Yao* (Paeonia) and *Da Zao* (Jujube).⁹⁵ The principles and many of the herbs used by Shiduo Chen remain in TCM and TCVM treatment of cognitive dysfunction through the present day.^{100,101}

The classic Chinese literature also references the use of acupuncture and moxibustion in treating cognitive decline. In a review on acupuncture therapy for dementia recorded in 93 ancient books, common acupoints were identified (Table 1).¹⁰² In the treatment of dementia, ancient practitioners used acupuncture therapy to regulate *Qi*. In *Qiong Yao Shen Shu* (Fine Jade Devine Book) written in the Song Dynasty, *Shen-men* (HT-7) and *Zu-san-li* (ST-36) were suggested treatments.^{102,103} The acupoint *Shen-men* (HT-7) is the *Yuan*-source point of the Heart Meridian, where the Heart *Qi* is said to enter and

exit.¹⁰² In the Ming Dynasty clinical text *Yi Xue Gang Mu* (Systematic Medical Studies), acupuncture at *Shen-men* (HT-7) and *Hou-xi* (SI-3) was recommended.¹⁰² The acupoint *Hou-xi* (SI-3), as the opening point of the Governing Vessel Meridian, is said to clear the Mind.¹⁰⁴ The ancient Chinese also selected the *Jing*-well acupoints to open the orifices and awaken the brain.¹⁰² In the *Zhen Fang Liu Ji* (Six Collections of Acupuncture Prescriptions), Wu Kun proposed using moxibustion cones at *Shao-shang* (LU-11) and *Yin-bai* (SP-1). In cases of dementia due to *Qi*-Blood Deficiency, moxibustion was performed at *Guan-yuan* (CV-4) to nourish *Qi* and Blood.¹⁰² In the classical work *Bian Que Xin Shu* (Book of Bian Que's Mind, 1146 C.E.), using moxibustion cones at *Guan-yuan* (CV-4) was suggested for mental disturbance due to Heart Blood Deficiency. This acupoint has a calming effect on the Mind.¹⁰⁴ The ancient Chinese knowledge and techniques described still apply in TCM and TCVM treatment of cognitive decline in modern clinical practice.¹⁰⁵

TRADITIONAL CHINESE VETERINARY MEDICINE

Chinese Medical Theory for Canine Cognitive Dysfunction

In Chinese medical theory, the *Shen* or Spirit is housed in the Heart and is associated with mental clarity, memory and sleep.^{100,106} The substances of the Heart are essential to mental activity and brain function, thus a Deficiency of Heart *Qi* or *Yin*-Blood creates loss of *Shen* and affects cognitive abilities. Additionally, there is a close relationship between the Heart and Kidney and cognition.¹¹ The Kidney *Jing* nourishes the brain while the Heart balances its activity. It is possible to see a decline in cognition with a Deficiency of Kidney *Jing*. In the Chinese medical paradigm, the Spleen is also involved in cognitive ability, as it provides the movement of fluids.^{95,100,106} A Deficiency of Spleen *Qi* causes accumulation of fluids and generation of non-substantial Phlegm that is said to mist the Mind and obstruct the *Shen*. As Aβ plaques in the brain are considered Phlegm or local Blood Stagnation, this pathological buildup obstructs the flow of *Qi* and impedes neuronal transmission, affecting cognitive function.

Table 1: Acupuncture points used to treat cognitive decline referenced in ancient texts¹⁰²

Source	Action/Indication	Acupoints
Review - 93 ancient books ¹⁰²	Common acupoints for dementia	<i>Shen-men</i> (HT-7), <i>Shao-shang</i> (LU-11), <i>Da-zhong</i> (KID-4), <i>Yin-bai</i> (SP-1), <i>Hou-xi</i> (SI-3), <i>Xin-shu</i> (BL-15), <i>Yong-quan</i> (KID-1), <i>Jiu-wei</i> (CV-15), and <i>Bai-hui</i> (GV-20)
<i>Qiong Yao Shen Shu</i> (Fine Jade Devine Book)	Regulate <i>Qi</i>	<i>Shen-men</i> (HT-7) and <i>Zu-san-li</i> (ST-36)
<i>Yi Xue Gang Mu</i> (Systematic Medical Studies)	Regulate <i>Qi</i>	<i>Shen-men</i> (HT-7) and <i>Hou-xi</i> (SI-3) using reinforcing, reducing, and moxibustion techniques
<i>Zhen Fang Liu Ji</i> (Six Collections of Acupuncture Prescriptions)	<i>Jing</i> -well acupoints: opens the orifices and awakens the brain	Moxibustion cones at <i>Shao-shang</i> (LU-11) and <i>Yin-bai</i> (SP-1)
<i>Bian Que Xin Shu</i> (Book of Bian Que's Mind)	Nourish <i>Qi</i> and Blood; Heart Blood Deficiency	Moxibustion cones at <i>Guan-yuan</i> (CV-4)

In TCVM, the Deficiency patterns seen in CCD may include Heart and Spleen *Qi* Deficiency, Heart *Yin*-Blood Deficiency, and Kidney *Jing* Deficiency, while the Excess patterns are Phlegm or Phlegm Fire Misting the Mind, *Qi*-Blood Stagnation and Liver *Qi* Stagnation (Table 2).^{11,100,106} These imbalances in the body are addressed with TCM treatment principles of tonify Spleen *Qi* to support Heart *Qi*, tonify Heart *Qi* to support the *Shen* and tonify Heart *Yin*-Blood.^{11,100} In addition, treatment principles to address Excess include dispel Phlegm to remove obstruction of *Shen*, clear Fire, resolve *Qi*-Blood Stagnation and soothe Liver *Qi*. In TCM theory, Kidney *Jing* declines with aging and since it is the origin of Kidney *Yin* and Kidney *Yang*, a Deficiency of these may also be present.¹¹ It is important to treat Kidney *Jing* Deficiency in these geriatric patients by nourishing *Jing*, nourishing Kidney *Yin* or warming Kidney *Yang*, and tonifying Spleen to support Post-natal *Jing*.

Clinical Studies

In current veterinary literature, 2 clinical trials and a case report describe the use of CHM to treat signs of CCD. One is a randomized double-blind controlled study by Hielm-Bjorkman et al. assessing the effect of Panax ginseng in combination with brewers' yeast in older dogs with geriatric clinical signs.¹⁰⁷ In this study, the efficacy was measured with questionnaires and visual analogue scales (VAS). At the end of an 8-week study period, dogs given Panax ginseng significantly improved in comparison with a brewers' yeast control in 4 of 7 mental variables: alertness-interest in surroundings, forgetfulness, alertness VAS and quality of life VAS. There were no side effects reported during the study period. It was concluded that Panax ginseng plus yeast is more effective than yeast alone in improving quality of life. This study is of interest, as Panax ginseng has been used as a tonic in traditional CHM for thousands of years.¹⁰⁸ The ginseng root contains numerous ginsenosides that are likely to be the active ingredients.¹⁰⁷ Effects have been associated with the ginsenoside Rb1, a neuroprotective molecule that has been shown to increase neural proliferation and differentiation of progenitor cells in the dentate gyrus of the hippocampus.¹⁰⁷

In China, extracts from the leaves of Ginkgo biloba have also been used therapeutically for centuries.¹⁰⁹ It is reported that the Ginkgo leaf extract contains terpene lactones and flavonoids that may help support cerebral blood circulation.³⁸ In an open 8-week clinical trial, Reichling et al. assessed the efficacy of Ginkgo leaf extract in reducing behavioral disturbances in elderly dogs with cognitive decline.³⁸ It is reported that 5 of 6 protocol-determined clinical signs were significantly improved: disorientation, sleep and activity changes, behavioral changes, general behavior and general physical condition. The overall severity of the geriatric condition in the patients was significantly reduced, with a positive effect apparent at 4 weeks ($p = 0.0002$). In this study, 15 (36%) of the patients were free of clinical signs at the end of the treatment period, and overall efficacy was good or very good in 79% of the dogs, as determined by the

investigator. No serious side effects related to the Ginkgo extract were seen. The study concluded that Ginkgo leaf extract as a dietary supplement appears to be safe and effective in the treatment of elderly dogs with cognitive decline and may increase their quality of life.³⁸

In a case report by Fowler, a geriatric dog with clinical signs of *Shen* Disturbance was successfully treated with CHM.¹¹⁰ The 14-year-old spayed female mixed breed dog with a Water constitution was experiencing severe anxiety, disorientation, inability to sleep and anorexia. The patient had received selegiline, valerian root extract, melatonin, acepromazine and Rescue Remedy^k, without a clinical response. An inadequate response was seen to fluoxetine and benzodiazepines. In the TCVM exam, signs of cognitive dysfunction, diminished *Shen*, extreme anxiety and mild to moderate fear were present. A clear TCVM Pattern was not apparent, and the patient was treated with the Chinese herbal medicines, *Er Yin Jian* combined with Stasis in the Mansion of the Mind^l. The Chinese herbal formula, *Er Yin Jian*, may be helpful in behavioral disturbance without a clear *Zang-fu* organ pattern. Stasis in the Mansion of the Mind^l is indicated for treatment of cognitive dysfunction.¹¹¹ In this patient, an improvement was seen within 2 weeks, including sleeping soundly at night, showing interest in surroundings and family, a return of normal appetite and discontinuance of hiding and obsessive-compulsive behaviors. The patient was well maintained on the 2 CHM formulas. The clinical findings from this case and the 2 clinical trials suggest that CHM may be beneficial in treating signs of CCD. It is interesting that some of the Chinese herbs used, such as ginseng and ginkgo, may also be considered as foods.^{11,112,113}

TRADITIONAL CHINESE VETERINARY MEDICINE FOOD THERAPY

In Chinese medicine a diagnosis is made based on *Bian Zheng*, a system of TCM/TCVM Pattern differentiation.¹¹⁴ The method of *Bian Zheng* is based on determining a patient's pattern using *Si Zhen* (the Four exams).^{11,114} In CCD, most patients present with a Deficiency Pattern due to the progressive nature of the disorder.¹¹ A pathogenic factor, however, may also be present. According to Koh, the Root is commonly associated with a Deficiency, and the Manifestation with an Excess.¹¹ It is suggested to resolve the Excess first if it is caused by the Root pattern to prevent further pathological change. Otherwise, the Deficiency is treated first or they may be treated together.

In TCVM, the treatment of CCD combines acupuncture, CHM, *Tui-na* and food therapy. This approach may be effective as a sole therapy or combined with conventional medicine for integrative treatment of these patients.¹¹ In ancient Chinese texts, it is said that food therapy is helpful in balancing the body. In *Plain Questions: On Soup and Mash*, written more than 2000 years ago, it states that grains boiled for a time and made into mash will nourish the *Zang* organs.¹¹³ A section in *Plain Questions* also describes the distribution of the five

flavors of food. Bitter food is said to be associated with the Heart and Spirit (*Shen*) and may be helpful in CCD patients: asparagus, cauliflower, broccoli, kale, bitter melon, amaranth (slightly bitter), parsley, ginkgo, and apple cider or Chinese fermented vinegar.^{11,91,100,112,113} In this work, salty foods are said to benefit the Kidney: salmon, clam, crab, mussel, oyster, abalone, anchovy, sardines, seaweed, kelp, alfalfa sprouts, tofu, barley, millet, chia seed and parsley.^{11,91,100,112,113} Sweet foods will benefit the Spleen: pumpkin, sweet potato, yam, shiitake mushroom, oats, black sesame seed, ginseng and honey.^{91,100,112,113} It may be helpful to add kidney beans or black beans to benefit the Kidney as well as strawberries or blueberries to provide antioxidants.¹¹

Deficiency Patterns

Heart and Spleen *Qi* Deficiency

In the pattern of Heart and Spleen *Qi* Deficiency, a diagnosis is based on signs of progressive cognitive decline with depression of the *Shen*.¹¹ If Heart *Qi* is deficient, the *Shen* will be depressed and the spirit is lost.¹¹² If the Spleen is also affected, fatigue and depression worsen. Some clinical signs are sleeping more, lessened social interaction/responsiveness, quietness and fearfulness.^{11,112} The patient may have decreased appetite, weakness, a desire to lie down and panting due to shortness of breath, with clinical signs worse during the day (*Yang* time).^{11,104,115} It is possible to see loss of housetraining or other learned behaviors, poor memory and inability to recognize family/friends as the disease progresses.^{11,100} In a TCVM exam, the tongue is pale and wet, possibly with a white coating.^{11,112} The pulse is deep and weaker on the right, particularly in the Spleen position.^{11,100} Treatment principles are tonify Heart and Spleen *Qi* and calm the *Shen*.¹¹

In this pattern, the aim of food therapy is to tonify *Qi*, so neutral and warming foods are used.¹⁰⁰ Foods to tonify Spleen *Qi* include carrot, pumpkin, winter squash (acorn, butternut) and sweet potato (Table 2).^{11,100,112} Foods that tonify both Heart and Spleen *Qi* include salmon, chicken egg yolk, chickpeas and pecan.¹¹² Cardamom and ginger warm the Middle *Jiao* (*Zhong Jiao*) and will benefit the Spleen. Foods with heavy mineral content, such as chicken eggshell, calm the *Shen*. It is recommended to avoid Cold or raw foods and Damp engendering foods such as dairy, saturated fats and dry processed foods.^{11,100,112}

Heart *Yin* and Blood Deficiency

A diagnosis of Heart *Yin* and Blood Deficiency is based on signs of progressive cognitive decline along with increasing anxiety and restlessness at night.^{11,100,112} It is said that Heart *Yin* and Blood nourish the *Shen*.¹¹⁵ In a Deficiency of these substances, the *Shen* will not be nourished or calm.^{112,115} Some signs are less responsiveness, listlessness, loss of housetraining and poor memory.^{11,112} In the evening there may be pacing, barking, sleeping poorly or staying awake at night. It is said that clinical signs are worse in the evening (*Yin* time). It is possible to

see cool-seeking behavior and other Warm signs due to *Yin* Deficiency, yet the coolness of Blood Deficiency may lessen their appearance.¹⁰⁰ The patient may have signs of dryness, such as dry skin, pads and nails.¹¹² In the TCVM exam, the tongue is dry, red or pale, with crack lines and little coating.^{11,112} The pulse is deep, thin and weak, especially on the left. Treatment principles are nourish Heart *Yin* and Blood and calm the *Shen*.

In this case, the aim of food therapy is to nourish Heart *Yin* and Blood. A few foods to nourish Heart *Yin* include chicken egg white, yogurt, mung bean and lima bean (Table 2).¹¹² It is recommended to avoid foods with a Hot or *Yang* energy and dry food, as it is heating and may contribute to *Yin*-Blood Deficiency.^{100,112} In addition, foods to nourish Heart Blood may be given, e.g. tuna, beets, lima beans and dates.¹¹² *Yin* and Blood tonics in general are also used.^{11,100,112} Omega-3 fatty acids found in fish oil and krill oil are considered to be *Yin* and Blood tonics.¹¹²

Kidney *Jing* Deficiency

Kidney *Jing* declines in aging animals, and a deficiency may be seen in geriatric patients with CCD.¹¹ In these patients, serial exams are needed, as a Deficiency of Kidney *Yin* or *Yang* may arise and will need distinct foods as therapy.^{11,100} In chronic patterns, long-term injury to Kidney *Yin* may result in depletion of Kidney *Yang* and vice versa, as these are mutually dependent.¹¹ A pale tongue, weak pulse and signs of *Qi* Deficiency reflect a Deficiency of Kidney *Jing*.^{100,112,115} Treatment principles are nourish Kidney *Jing*, nourish Kidney *Yin* or warm Kidney *Yang*, tonify Spleen to support post-natal *Jing* and support the Water element.^{11,112} Food therapy is given according to the presenting deficiencies.

In Deficiency of Kidney *Jing*, the aim is to supplement with foods that nourish *Jing*, e.g. foods that “start life” (seeds, eggs, nuts), sea cucumber, alfalfa and artichoke leaves (Table 2).¹¹² It is recommended to avoid an abundance of Cold or raw foods.¹¹² It is also helpful to offer foods and supplements to nourish post-natal *Jing*, e.g. salmon, yams, kidney beans and black beans.¹¹² Spleen *Qi* tonics, especially those that benefit or enter the Kidney Channel, are used. It is recommended to avoid highly processed dry foods, as these foods provide little nourishment for post-natal *Jing*.¹¹² It is beneficial to support the Water element and *Jing* using salty foods, such as kelp and seaweed, and dark foods, such as black-eyed peas, black beans, blackberries and black sesame seeds.¹¹²

In *Yin* Deficiency, a diagnosis is based on signs of progressive decline in cognition along with clinical signs of Heat and hind end weakness or lumbar pain.^{11,112,115} A Deficiency of *Yin* is described as the inflammatory component of CCD.¹³ It is possible to see poor memory, restlessness, evening anxiety and difficulty falling asleep at night.^{11,112} There may also be signs of dryness.¹¹² Heat signs may include panting, drinking small amounts of water frequently, cool or shade seeking and warm ears and/or paws.^{11,112} The clinical signs are worse in late

evening or at night (*Yin* time). In the exam, a red or deep red and dry tongue with crack lines and little to no coating may be seen. The pulse is fast, deep, thin and weaker on the left.

If *Yin* Deficiency is present, the intent is to clear False Heat and nourish Kidney *Yin*.¹⁰⁰ *Yin* tonics that are cooling, moistening and replenish Body Fluids are given.¹¹² Some cooling foods that tonify Kidney *Yin* are scallop, clam, asparagus and seaweed (Table 2).¹¹² A few cooling foods to replenish Body Fluids include asparagus, spinach, lemon and pear. Fish oil is considered a Cool *Yin* tonic. It is recommended to avoid Hot or *Yang* foods, highly refined foods/carbohydrates, and dry food.^{11,112} In patients with *Yin* Deficiency, it is suggested to avoid giving cold food or ice cold water, as this decreases stomach acid, impairs digestion and engenders Dampness/Phlegm.¹¹²

In *Yang* Deficiency, a patient may present with signs of Cold, extreme weakness in rear limbs or back, and lumbar pain.^{11,112,115} There may be lethargy, depression and hypersomnia, along with decreased appetite, early morning diarrhea and urinary or fecal incontinence.^{11,112} Cold signs may include aversion to cold, warm/heat seeking, and cool to cold ears, back and extremities.^{11,112,115} In the TCVM exam, the tongue may be pale to lavender, wet and swollen. The pulse is slow, deep and weak, especially on the right in the Kidney position.

If *Yang* Deficiency is present, foods that clear False Cold and tonify Kidney *Yang* are given, e.g. shrimp, prawns, milk (goat/sheep) and pistachio (Table 2).^{11,91,112} As Deficiency of *Yang* affects the Spleen, foods that warm the Spleen are helpful in draining Dampness.¹¹² *Yang* tonics are usually sweet to nourish the Spleen and pungent to disperse Stagnation created by Cold in the Channels. It is recommended to avoid Cold or raw foods, cold water intake, and added salt, as it may increase water intake and exacerbate the condition.^{11,112}

Excess Patterns

Phlegm Misting the Mind

In Phlegm Misting the Mind, the patient may have an underlying Deficiency of Spleen *Qi*, with increased Dampness due to inability to move fluids.¹¹ In this case, non-substantial Phlegm may be created and enter the Channel connecting the Heart with its orifice, causing obstruction of the *Shen*.^{100,115} Some signs include mental confusion/depression, lethargy, a change in voice, vomiting of phlegm and dull eyes.^{11,104} It is also possible to see other signs of Spleen *Qi* Deficiency.¹¹² In the TCVM exam, the tongue is pale and wet with a thick coating and may be swollen with a midline crack extending to the tip.^{11,104,112} The pulse is slippery, possibly reflecting Dampness. The treatment principle is transform Phlegm and open the orifices of the Heart.¹¹

In this pattern, supplementing with foods to transform Phlegm is suggested, e.g. shrimp, mustard greens, radish and daikon (Table 2).^{11,100,112} Conventional herbs to transform Phlegm include peppermint leaves, thyme and watercress.¹¹² It is helpful to use foods to tonify Spleen *Qi* in these patients. It is recommended

to avoid foods that create Dampness such as dairy or peanut butter, Cold or raw foods and dry highly processed pet foods.¹¹²

Phlegm Fire Misting the Mind

In this pattern, there is obstruction of the orifice of the Heart and misting of the Mind by Phlegm and Fire.¹⁰⁴ A diagnosis is based on signs of Heat in combination with the clinical signs of Phlegm Misting the Mind. The signs include manic or strange behavior such as tail chasing or sudden severe outbursts, irritability, aggressiveness and restlessness.^{11,104,112} It is also possible to see mental depression and dullness.^{11,104} Heat signs include increased thirst, cool seeking, and warm ears, back and paws.^{11,100} The tongue is red to deep red, possibly with a yellow coating and/or swollen, and the tip may be redder or have red points.^{11,104,112} The pulse is fast, full and slippery if Damp is present.^{11,112} The treatment principles are transform Phlegm, clear Fire and calm *Shen*.^{11,112}

The aim of food therapy is to provide supportive treatment to transform Phlegm and clear Fire (e.g. bamboo sprouts, daikon, seaweed and kelp) [Table 2].^{11,100,112} *Yin* tonics, such as lemon and pear, protect the Heart *Yin* from damage due to Fire.¹¹² It is said that foods with bitter taste benefit the Heart and are helpful to drain Dampness. It is recommended to avoid Hot or *Yang* foods, Damp engendering foods such as dairy or oily food, and dry highly processed pet food, as it creates Dampness and Heat.^{11,91,100,112}

Qi-Blood Stagnation

As *Qi* is needed to move Blood and Blood is needed to carry *Qi*, a Deficiency of either may cause *Qi* and Blood to become Stagnant in the Brain and affect cognition.¹⁰⁰ This correlates to the microvascular pathology seen in CCD.¹³ Some signs are sleeping less, lessened social interaction/responsiveness and irritability.^{11,104,115} It is possible to see loss of housetraining or other learned behaviors, getting lost in corners and wandering in the home.¹¹ The patient may also have weakness and coolness in limbs. In the exam, the tongue may be pale purple or purple on the sides. Pulses may be wiry in *Qi* Stagnation or choppy in Blood Stagnation.^{11,112} The treatment principles are move Heart *Qi* and Blood, resolve Stagnation, and open the orifices of the Heart.¹¹

In this case, it is helpful to include foods to move stagnant *Qi* and Blood, e.g. shrimp, crab, mustard greens and kale (Table 2).^{11,100,112} The sweet and pungent tastes stimulate the circulation of *Qi* and Blood.¹¹² It is recommended to avoid foods that create Dampness, such as dairy, and diets with an overall Hot energy.¹¹²

Liver Qi Stagnation

The Liver controls healthy *Qi* flow and mental state.¹¹⁵ A stagnation of Liver *Qi* may transform into Fire and disturb the *Shen*. It may also interfere with the activity of the Spleen and digestion. A patient may present with irritability, aggressiveness, fluctuation in mental state, depression and pain or distension in the hypochondrium.^{11,104,112,115} It is also possible to see nausea,

vomiting, diarrhea or constipation and a decreased appetite, possibly reflecting interference with the Spleen.^{11,115} Heat signs may include increased thirst and conjunctival redness.^{11,104,112} In the exam, the tongue may be pink to red or lavender and may have strawberry dots on the sides if there is Liver Heat.^{11,104,112} The pulse is wiry, particularly on the left.^{11,104} The treatment principles are soothe Liver *Qi*, strengthen Spleen and Stomach, and calm *Shen*.^{11,112}

It is helpful to supplement with items to soothe Liver *Qi*, e.g. spinach, dandelion greens, celery and carrots (Table 2).^{11,112} Foods to circulate *Qi*-Blood, such as peppermint leaves and vinegar, are helpful.¹¹² It is said that green foods and sour foods will benefit the Liver.^{112,113} It is recommended to avoid foods that create Dampness e.g. dairy, excess fats and processed foods, Hot or *Yang* foods, and feeding a large meal, as this may add to Stagnation and Heat.¹¹²

Table 2: Summary of Chinese food therapy to treat TCVM patterns associated with Canine Cognitive Dysfunction

Pattern	Clinical Signs ^{11,100,104,112,115}	Food Therapy ^{11,91,100,112,113}
Deficiency Patterns		
Heart and Spleen <i>Qi</i> Deficiency	Depression of <i>Shen</i> , sleeping more, lessened social interaction/responsiveness, quietness, fearfulness; decreased appetite, weakness, a desire to lie down, panting due to shortness of breath; clinical signs worse during the day (<i>Yang</i> time); loss of housetraining/other learned behaviors, poor memory, inability to recognize family/friends as disease progresses <u>Tongue</u> : pale, wet, possibly with white coating <u>Pulse</u> : deep and weaker on the right, particularly in the Spleen position	<u>Tonify Spleen <i>Qi</i></u> : carrot, pumpkin, winter squash (acorn, butternut), sweet potato, yam, black-eyed peas, sweet rice, oats <u>Tonify both Heart and Spleen <i>Qi</i></u> : salmon, chicken egg yolk, chickpeas, pecan, Chinese ginseng, licorice root Cardamom and ginger warm the Middle <i>Jiao</i> (<i>Zhong Jiao</i>) to benefit the Spleen; foods with heavy mineral content, such as chicken eggshell, calm the <i>Shen</i> <u>Avoid</u> : Cold or raw foods, Damp engendering foods (e.g. dairy, saturated fats, dry processed foods)
Heart <i>Yin</i> and Blood Deficiency	Increasing anxiety/restlessness at night, pacing, barking, sleeping poorly, staying awake; less responsiveness, listlessness; loss of housetraining, poor memory; clinical signs worse in the evening (<i>Yin</i> time); cool seeking behavior and other Warm signs due to <i>Yin</i> Deficiency; coolness of Blood Deficiency may lessen their appearance; signs of dryness: dry skin, pads and nails <u>Tongue</u> : dry, red or pale, crack lines, little coating <u>Pulse</u> : deep, thin and weak, especially on the left	Nourish Heart <i>Yin</i> : chicken egg white, yogurt, mung bean, lima bean, blueberry, persimmon, watermelon, wheat (bran) <u>Nourish Heart Blood</u> : tuna, beets, lima beans, dates <i>Yin</i> and Blood tonics are also used; omega-3 fatty acids found in fish oil and krill oil are <i>Yin</i> and Blood tonics <u>Avoid</u> : Hot or <i>Yang</i> foods, dry food
Kidney <i>Jing</i> Deficiency	Signs of <i>Qi</i> Deficiency <u>Tongue</u> : pale <u>Pulse</u> : weak	<u>Nourish <i>Jing</i></u> : foods that “start life” (e.g. seeds, eggs, nuts), sea cucumber, alfalfa, artichoke leaves, yams, black-eyed peas, black beans, kidney beans, goji berries, blackberries, black sesame seeds <u>Nourish post-natal <i>Jing</i></u> : salmon, yams, kidney beans, black beans, black-eyed peas, lotus seed, sunflower seeds <u>Spleen <i>Qi</i> tonics</u> , especially those that benefit or enter the Kidney Channel, are used <u>Support Water element and <i>Jing</i></u> : salty foods (e.g. kelp, seaweed), dark foods (e.g. black-eyed peas, black beans, blackberries, black sesame seeds) <u>Avoid</u> : an abundance of Cold or raw foods, highly processed dry foods
Kidney <i>Yin</i> Deficiency	Hind end weakness or lumbar pain; poor memory; restlessness, evening anxiety, difficulty falling asleep at night; clinical signs worse in the evening/night (<i>Yin</i> Time); signs of dryness <u>Heat signs</u> : panting, drinking small amounts of water frequently, cool or shade-seeking, warm ears/paws <u>Tongue</u> : red/deep red, dry, crack lines, little to no coating <u>Pulse</u> : fast, deep, thin, weaker on the left	<u>Tonify Kidney <i>Yin</i></u> : scallop, clam, asparagus, seaweed, mulberry fruit, millet, chia seed <u>Replenish Body Fluids</u> : asparagus, spinach, lemon, pear, strawberry; fish oil is considered a cool <i>Yin</i> tonic <u>Avoid</u> : Hot or <i>Yang</i> foods, highly refined foods and carbohydrates, dry food, giving cold food or ice cold water
Kidney <i>Yang</i> Deficiency	Extreme weakness in rear limbs or back, lumbar pain; lethargy, depression, hypersomnia; decreased appetite, early morning diarrhea, urinary or fecal incontinence <u>Cold signs</u> : aversion to cold, warm/heat seeking, and cool to cold ears, back and extremities <u>Tongue</u> : pale to lavender, wet, swollen <u>Pulse</u> : slow, deep and weak, especially on the right in the Kidney position	<u>Clear False Cold and tonify Kidney <i>Yang</i></u> : shrimp, prawns, milk (goat/sheep), pistachio, stir-fried walnuts, oats, quinoa, cinnamon (bark), clove, cumin; foods that warm the Spleen are helpful in draining Dampness; <i>Yang</i> tonics are usually sweet to nourish the Spleen and pungent to disperse Stagnation created by Cold in the Channels <u>Avoid</u> : Cold or raw foods, cold water, added salt

Table 2 (continued)

Pattern	Clinical Signs ^{11,100,104,112,115}	Food Therapy ^{11,91,100,112,113}
Excess Patterns		
Phlegm Misting the Mind	Mental confusion/depression; lethargy, change in voice, vomiting of phlegm, dull eyes; other signs of Spleen <i>Qi</i> Deficiency <u>Tongue</u> : pale, wet, thick coating, may be swollen with a midline crack extending to tip <u>Pulse</u> : slippery, possibly reflecting Dampness	<u>Transform Phlegm</u> : shrimp, mustard greens, radish, daikon, winter squash, shiitake or white button mushroom, apple, lemon, persimmon, almonds, walnuts, licorice root, peppermint leaves, thyme, watercress; helpful to use foods to tonify Spleen <i>Qi</i> <u>Avoid</u> : Damp engendering foods (e.g. dairy, peanut butter), Cold or raw foods, dry highly processed pet foods
Phlegm Fire Misting the Mind	Manic or strange behavior such as tail chasing or sudden severe outbursts; irritability, aggressiveness, restlessness; mental depression, dullness <u>Heat signs</u> : increased thirst, cool-seeking, and warm ears, back and paws <u>Tongue</u> : red/deep red, possible yellow coating, may be swollen; tip may be redder or have red points <u>Pulse</u> : fast, full, slippery if Damp is present	<u>Transform Phlegm and clear Fire</u> : bamboo sprouts, daikon, seaweed, kelp, water chestnut, white button mushroom, lemon, pear; <i>Yin</i> tonics, such as lemon and pear, protect the Heart <i>Yin</i> from damage due to Fire; foods with bitter taste benefit the Heart and help drain Dampness <u>Avoid</u> : Hot or <i>Yang</i> foods, Damp engendering foods (e.g. dairy, oily food), dry highly processed pet foods
<i>Qi</i> -Blood Stagnation	Sleeping less; lessened social interaction/responsiveness; irritability; loss of housetraining/other learned behaviors, getting lost in corners, wandering in the home; weakness and coolness in limbs <u>Tongue</u> : pale purple or purple on sides <u>Pulse</u> : wiry in <i>Qi</i> Stagnation, choppy in Blood Stagnation	<u>Move stagnant <i>Qi</i> and Blood</u> : shrimp, crab, mustard greens, kale, carrot, peach, hawthorn berry, sweet rice, turmeric, tangerine peel (dried), and apple cider, Chinese fermented, or rice vinegar in small amounts; sweet and pungent tastes stimulate circulation of <i>Qi</i> and Blood <u>Avoid</u> : Damp engendering foods (e.g. dairy), diets with an overall Hot energy
Liver <i>Qi</i> Stagnation	Irritability, aggressiveness, fluctuation in mental state, depression; pain/distension in hypochondrium; nausea, vomiting, diarrhea or constipation, decreased appetite <u>Heat signs</u> : increased thirst, conjunctival redness <u>Tongue</u> : pink to red or lavender, may have strawberry dots on sides if there is Liver Heat <u>Pulse</u> : wiry, particularly on the left	<u>Soothe Liver <i>Qi</i></u> : spinach, dandelion greens, celery, carrots, green apples, peppermint leaves, licorice root, honey, apple cider or rice vinegar in small amounts; foods to circulate <i>Qi</i> -Blood (e.g. peppermint leaves, vinegar) are helpful; green foods/sour foods benefit the Liver <u>Avoid</u> : Damp engendering foods (e.g. dairy, excess fats, processed foods), Hot or <i>Yang</i> foods, feeding a large meal

CONSIDERATIONS – HUMAN LITERATURE

In humans, certain dietary patterns may lessen the risk and progression of cognitive decline. It is reported that a diet containing fruits and vegetables, nuts, whole grains, fish, omega-3 fatty acids, probiotics, soybeans and MCTs, may be beneficial.^{10,54,116-118} A three-city cohort study conducted in France showed that a diet including fruits and vegetables consumed daily may decrease the risk of dementia in humans.¹¹⁹ The study also found that frequent intake of fish and omega-3 rich oils may lessen the risk of AD and dementia, particularly in non-carriers of the ApoE ε4 allele, a risk factor of late-onset AD. In another study, the benefit of vitamin C in fruits and vegetables, as well as vitamin E in grains, nuts and other foods has been described.¹²⁰ This study determined that a high intake of vitamin C and vitamin E in foods may be associated with a lower risk of incident AD. In some studies, red meat, refined sugar, saturated fats and high-fat dairy foods are noted as detrimental to cognition.¹¹⁶⁻¹¹⁸ As the pathology is similar in CCD and AD, the findings in these studies are consistent with the idea that dietary patterns may be helpful in lessening the risk and progression of cognitive decline in dogs.¹⁰

It is possible that specific dietary patterns may help in preventing cognitive decline by influencing the composition of bacteria in the gastrointestinal system.^{121,122}

In humans, a diet including high level consumption of fruits, vegetables, legumes and cereals may have anti-inflammatory effects in association with microbiome alterations.^{122,123} The alterations in phyla may also lead to an increase in intestinal short chain fatty acid (SCFA) levels.^{122,124} These bacterial metabolites are helpful to stimulate the release of serotonin, causing a positive effect on learning and memory, and also interfere with accumulation of Aβ.^{89,121,125,126} In one human study, measures of cognitive function were also improved.¹²²

From a Chinese medical viewpoint, the aim of food therapy is to prevent disease, remove illness and slow aging.¹¹³ In China, there is a long history of gerontology, with early monographs on health in aging.¹²⁷ In the *Yang Lao Shi Liao* (Medical Diet on Health Preservation for the Aged), written by Sun Simiao in approximately 680 C.E., it is said that using *Niu Ru* (milk), *Hei Zhi Ma* (black sesame) and *Feng Mi* (honey) in the elderly may lead to longevity. It is recommended that milk and honey be ingested warm and a little at a time. *Hei Zhi Ma* (black sesame) is said to nourish *Jing*, *Yin* and Blood and may benefit Kidney *Jing* and *Yin* Deficiency or Heart *Yin*-Blood Deficiency in CCD.^{91,100} It is known that black sesame contains lecithin and vitamin E that may help to maintain normal function of the brain and delay cell aging,

respectively.¹²⁷ Honey is said to supplement the middle and may help in the movement of fluids. In a recent study, spicy food that has a pungent taste is also reported to benefit cognition.¹²⁸ In Chinese medical theory, foods with a pungent taste are said to promote the flow of *Qi* and Blood and may be helpful in resolving *Qi*-Blood Stagnation.^{91,129}

INTEGRATING EAST AND WEST

It is possible that integrative dietary therapy may be the most helpful in cognitive decline. A recent paper reported that an increase in efficacy is found when combining Chinese food therapy (CFT) with conventional nutritional therapy in human studies.¹²⁹ As an example, Shen et al. found that foods with a Cold nature and high in potassium, magnesium, calcium and fiber were more effective in treating hypertension in patients with *Yin* Deficiency.^{129,130} It is interesting to note that many foods shown to lessen cognitive decline in humans have a neutral to Cold nature and may benefit patients with a Deficiency of *Yin*.¹³ According to Dewey et al., many canine patients with CCD show this pattern.¹³ It is possible with consideration of the extensive information in human literature, both ancient and modern, that a combination of syndrome differentiation in CFT and conventional nutritional therapy may help improve cognition and quality of life in canines with CCD.

In the literature, there is accumulating evidence that dietary therapy may be helpful to prevent or slow cognitive decline in canines.¹³ The nutritional supplements that demonstrate efficacy, such as SAME, may be added to a conventional diet or a CFT plan. In CFT, antioxidants, MCTs and other enrichment may be included in the diet, with consideration of the *Bian Zheng*, the TCVM Pattern of the patient. The fat sources may include fish oil, a *Yin*

Table 3: Calculated metabolizable energy (ME) for average elderly dog with potential amounts of coconut oil that can be used to help with canine cognitive dysfunction by providing a source of medium-chain triglycerides. It is recommended to use coconut oil conservatively, especially if treats are given. The extra calories are meant to replace some of the calories consumed in the diet.¹⁰

Dog weight (kg)	ME (kcal) ^m	10% ME Coconut oil
5	335	1 tsp (35 kcal)
10	570	1.5 tsp (53 kcal)
20	950	3 tsp (105 kcal)
30	1280	3.5 tsp (123 kcal)
40	1590	4.5 tsp (158 kcal)
50	1880	5 tsp (175 kcal)

^m = calculated from average ME for low-activity elderly dog–100(kg)^{0.75}; tsp = teaspoon

Adapted from: Dewey CW et al. Canine cognitive dysfunction: pathophysiology, diagnosis, and treatment.¹⁰

Table 4: Example of Cooling Diet for Dogs with CCD*

Ingredient	Amount
Baked whitefish (monkfish, cod, flounder, sole, haddock)	8 oz – weight after cooking
Cooked medium grain brown rice	¼ cup
Cooked spinach or Swiss chard	1 cup
Sesame oil	1 tsp
Fish oil	1 tsp
Coconut oil	1 tbsp
iviBlend (find at iviBlend.com)	1 scoop
Calcium carbonate powder (brand used - NOW)	½ tsp
After cooking, mix all ingredients on the day of the meal and partition into 2-3 meals per day.	
The foods may be prepared and kept refrigerated for up to 3 days before mixing into a daily ration that is fed over the day. Ration is 38% metabolizable energy from protein, 37% from fat, and 25% from carbohydrate.	
* Diet for a typical 10 kg dog (multiply for bigger dogs and decrease for smaller dogs)	
oz = ounce; tsp = teaspoon; tbsp = tablespoon	

Adapted from: Dewey CW et al. Food therapy for neurologic disorders. Integrative and Traditional Chinese Veterinary Medicine Food Therapy: Small Animal and Equine.¹³

tonic with a Cool energy, and coconut oil, considered as neutral to cool in Chinese medicine. Coconut oil may be used as a source of MCTs to supplement a diet in dogs at approximately 1-1.5 teaspoons per 10 lbs. of body weight (Table 3).^{10,13} An example of a CFT diet with a cooling protein and carbohydrate source is provided (Table 4). As clients are likely to consider dietary therapy, it is a useful option that may benefit cognition in canine patients.

SUMMARY

There is a growing body of literature demonstrating the importance of nutritional therapy when treating cognitive disorders in the dog. Modified diets and nutritional supplements rich in factors that support the nervous system such as antioxidants, MCTs and vitamins address neurodegenerative pathology associated with canine cognitive dysfunction. Traditional Chinese medicine has been used for centuries to treat cognitive decline and may be integrated with conventional nutritional therapy or used as a sole treatment. Chinese food therapy is based on diagnosis of a disease pattern of imbalance. Selection of foods that treat pattern deficiencies or excesses associated with CCD are then used to make up a balanced diet to treat the unique pattern observed in a patient. Integrative dietary therapy in CCD provides clinicians with a personalized treatment to help improve cognition and quality of life in their canine patients.

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FOOTNOTES

- ^a Canine b/d, Hill's Pet Nutrition, Inc., Topeka, KS, USA
- ^b Purina Pro Plan NeuroCare, Nestle Purina PetCare, Inc., St. Louis, MO, USA
- ^c Purina One Vibrant Maturity 7+Formula, Nestle Purina PetCare, Inc., St. Louis, MO, USA
- ^d Purina Bright Mind, Nestle Purina PetCare, Inc., St. Louis, MO, USA
- ^e Aktivait, VetPlus Ltd., Lytham St Anne's, UK
- ^f Senilife, Innovet Italia s.r.l., Milano, Italy
- ^g Zylkene, Ingredia, Arras, France
- ^h Anxitane, Virbac Animal Health, Fort Worth, TX, USA
- ⁱ Zentrol, Pegasus Laboratories, Pensacola, FL, USA
- ^j Solliquin, Nutramax Laboratories Veterinary Sciences, Inc., Lancaster, SC, USA
- ^k A Nelson & Co. Ltd., North Andover, MA, USA
- ^l Dr Xie's Jing Tang Herbal, Inc., Ocala, FL, USA

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