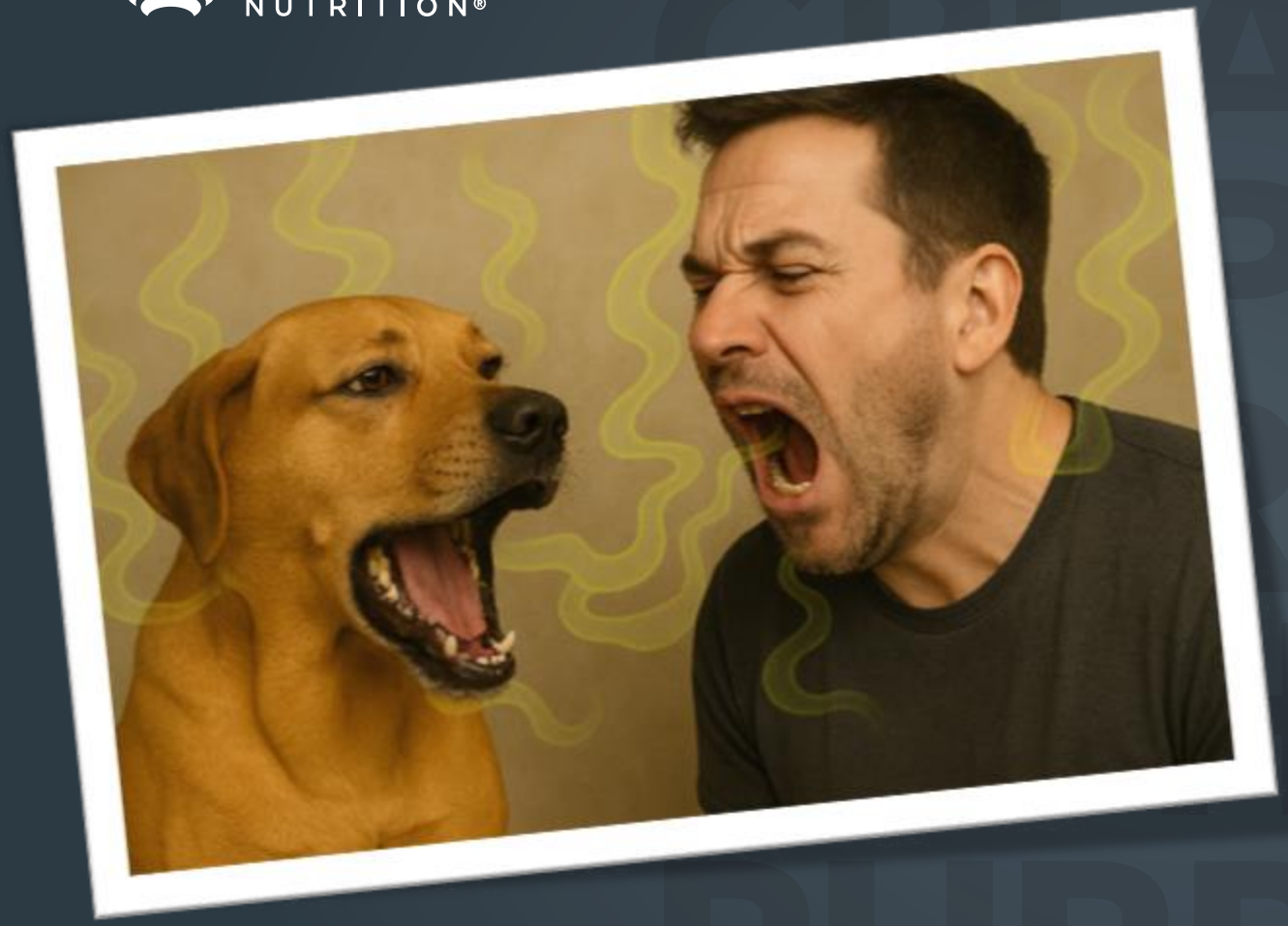

WOOF TO WHISPER:

Validated Microbiome Support for Oral Health in People and Pets

@stratumnutrition

Marie Parks, M.S.
Ingredient Science Specialist
Stratum Nutrition

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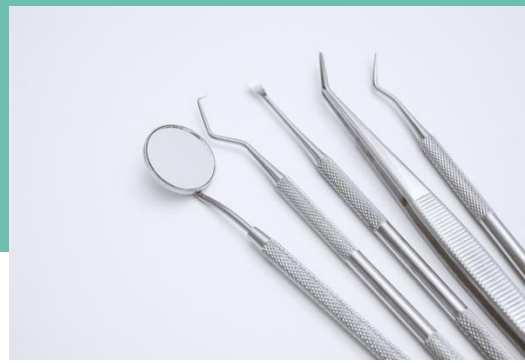
Oral Health
A Shared Concern for Humans and Pets

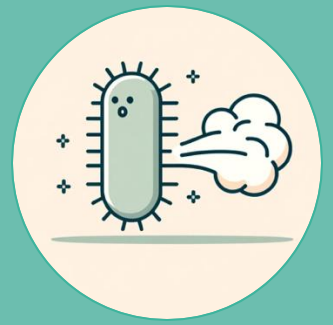


	Human	Pets

Oral Disease Prevalence	- *Oral diseases:* 3.5B
	- *Periodontal disease:*
	  o 30+ yrs.: 47.2%
	  o 65+ yrs.: 70.1%
	- *Halitosis:*
	  o 1 in 4 – chronic
	  o 50% - occasional
		- *Periodontal disease:*
		  o 80-90% of dogs and cats by age 3
		  o #1 diagnosed condition in dogs
		- *Halitosis:*
		  o 78% of dogs 3+ years

Oral Hygiene	- 51-60% brush 2x per day (ADA gold standard) - 30-42% floss daily (ADA gold standard)	- 2% of dog owners brush teeth daily - >50% of owners never brush
Health Risks		- 73% of dogs with periodontal disease have systemic comorbidities
	Oral bacteria → bloodstream → heart and organs = infections & inflammation → Heart, kidney, liver, metabolic, and brain diseases	

Causes



Bad breath
Morning breath
Dog breath

- In addition to periodontal diseases, there are many causes of 'unpleasant' breath (**halitosis**), such as:
  - poor oral hygiene routine
  - poorly maintained dentures/braces/retainer
  - diet (certain foods like garlic & onions, high-sugar, keto diet)
  - systemic conditions such as diabetes and digestive issues
- In *humans and canines*, the underlying cause is the presence of undesirable bacteria on the teeth and tongue
  - bacteria produce gases called **volatile sulfur compounds** (**VSCs**) that result in an unpleasant breath odor
- Culprits for producing VSCs are gram-negative anaerobes, which include *Fusobacterium sp* (i.e. ***F. nucleatum***) and *Porphyromonas sp* (i.e. ***P. gulae***, prominent in dogs), and closely related ***P. gingivalis*** (common in humans)
  - notorious VSCs: **hydrogen sulfide** (H_2S), **methyl mercaptan** (CH_3SH), and **dimethyl sulfide** ($(CH_3)_2S$)
- Not just subjective…VSCs can be measured using a gas chromatograph (OralChroma CHM-2)
  - **≥ 1.5 ng/10 mL**, or higher than 0.15 ppb cause discomfort to those around you and your pet
- Not just cosmetic – VSCs are cytotoxic to oral tissues leading to new or worsening dental issues
  - VSCs can also be transported via blood to other organs resulting in systemic issues

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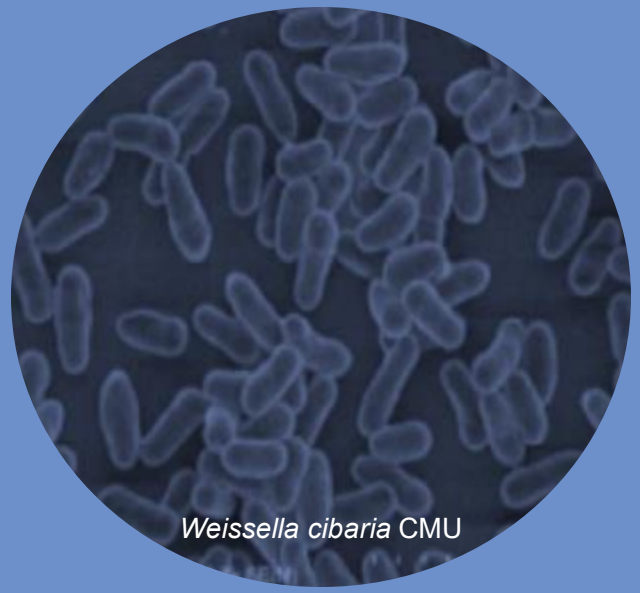
What is OraCMU™?



Weissella cibaria CMU

- Trademarked and patented oral probiotic strain of the *Weissella cibaria* (*W. cibaria)* species
- Discovered at **C**honnam **M**edical **U**niversity ("**CMU**") in Korea
- *W. cibaria* is a lactic acid producer that is essential in the fermentation of kimchi
  - However, the OraCMU™ strain was isolated from the saliva of healthy children due to its shown ability to produce hydrogen peroxide (known for its antibacterial and teeth whitening properties)
- Clinically-validated effects for oral health and bad breath
  - 9 human trials in healthy adults
  - 2 canine trials
- Efficacy and mechanisms also backed by:
  - 2 cell trials
  - 11 in vitro trials
  - 3 animal trials (non-canine)
    - + 5 safety trials, +3 viability trials (temperature)

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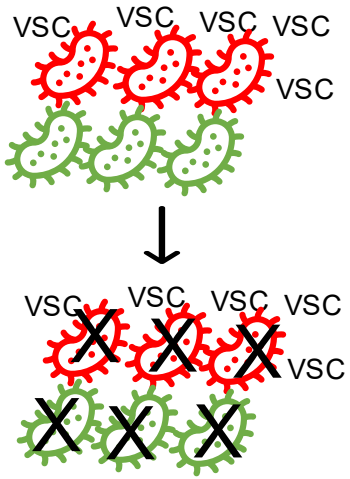
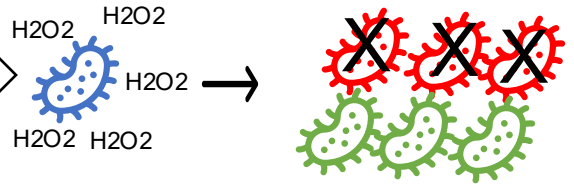
How does OraCMU™ work?

Oral probiotics are an alternative halitosis solution that target odor-causing bacteria while sparing helpful oral bacteria, preserving oral microbiome balance

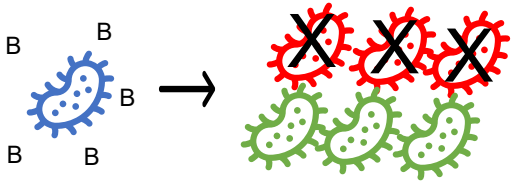
Current treatments take away both good and bad bacteria



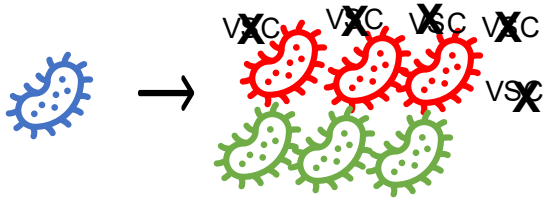
Produces high levels of **hydrogen peroxide** naturally, which breaks up undesirable bacterial biofilms



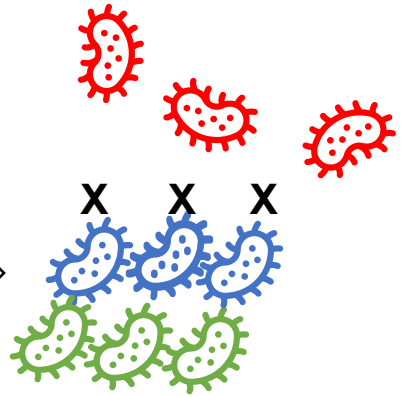
Produces **bacteriocin-like compounds** which target undesirable odor-causing bacteria



Specifically **reduces VSC production** by odor-causing bacteria



Colonizes the oral cavity quickly and effectively, **crowding out** undesirable odor-causing bacteria



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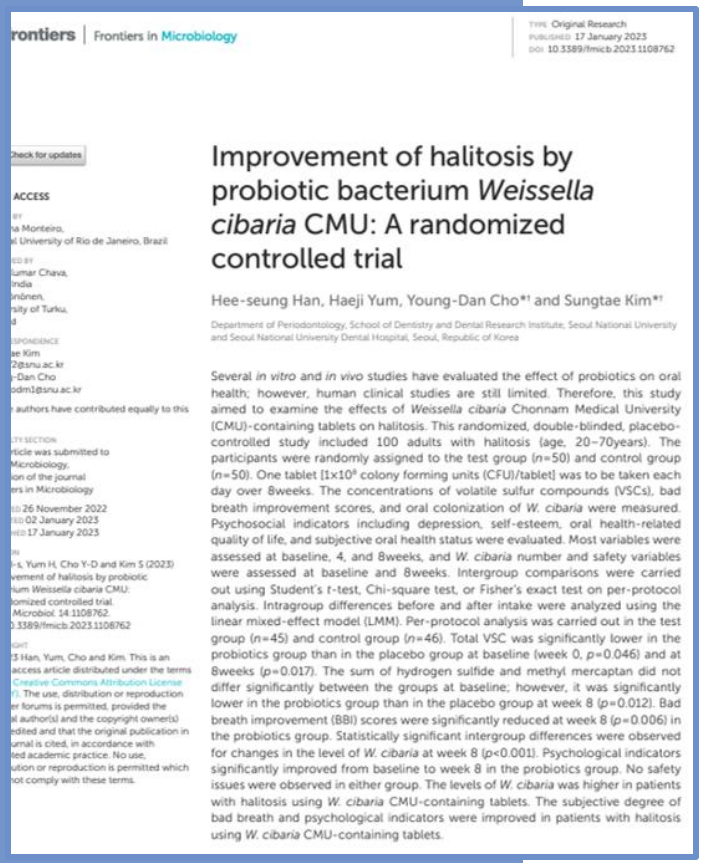
Han HS, et al. 2023



Frontiers | Frontiers in Microbiology

TYPE Original Research
PUBLISHED 17 January 2023
DOI 10.3389/fmicb.2023.1108762

Improvement of halitosis by probiotic bacterium *Weissella cibaria* CMU: A randomized controlled trial

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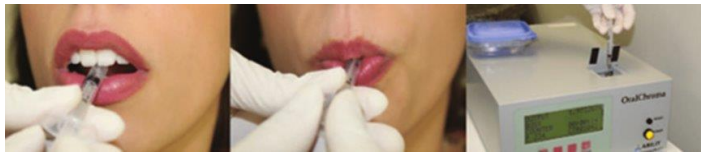
Department of Periodontology, School of Dentistry and Dental Research Institute, Seoul National University and Seoul National University Dental Hospital, Seoul, Republic of Korea

Several *in vitro* and *in vivo* studies have evaluated the effect of probiotics on oral health; however, human clinical studies are still limited. Therefore, this study aimed to examine the effects of *Weissella cibaria* Chonnam Medical University (CMU)-containing tablets on halitosis. This randomized, double-blinded, placebo-controlled study included 100 adults with halitosis (age, 20–70years). The participants were randomly assigned to the test group (n=50) and control group (n=50). One tablet [1×10^8 colony forming units (CFU)/tablet] was to be taken each day over 8weeks. The concentrations of volatile sulfur compounds (VSCs), bad breath improvement scores, and oral colonization of *W. cibaria* were measured. Psychosocial indicators including depression, self-esteem, oral health-related quality of life, and subjective oral health status were evaluated. Most variables were assessed at baseline, 4, and 8weeks, and *W. cibaria* number and safety variables were assessed at baseline and 8weeks. Intergroup comparisons were carried out using Student's t-test, Chi-square test, or Fisher's exact test on per-protocol analysis. Intragroup differences before and after intake were analyzed using the linear mixed-effect model (LMM). Per-protocol analysis was carried out in the test group (n=45) and control group (n=46). Total VSC was significantly lower in the probiotics group than in the placebo group at baseline (week 0, p=0.046) and at 8weeks (p=0.017). The sum of hydrogen sulfide and methyl mercaptan did not differ significantly between the groups at baseline; however, it was significantly lower in the probiotics group than in the placebo group at week 8 (p=0.012). Bad breath improvement (BBI) scores were significantly reduced at week 8 (p=0.006) in the probiotics group. Statistically significant intergroup differences were observed for changes in the level of *W. cibaria* at week 8 (p<0.001). Psychological indicators significantly improved from baseline to week 8 in the probiotics group. No safety issues were observed in either group. The levels of *W. cibaria* was higher in patients with halitosis using *W. cibaria* CMU-containing tablets. The subjective degree of bad breath and psychological indicators were improved in patients with halitosis using *W. cibaria* CMU-containing tablets.

- 8-week, randomized, double-blind, placebo-controlled
- 100 adults with halitosis (20-70 yrs)
  - total VSCs ≥ 1.5 ng/10 mL
- Dose: 100 million CFU OraCMU™ daily (let tablet dissolve in mouth before bed after brushing teeth)
- **Results at 8 weeks:**
  - **Total VSCs significantly lower in OraCMU™ vs. Placebo**



  - **Self-perceived halitosis significantly improved in OraCMU™ vs. placebo**

Jo SR, et al. 2020

Effect of probiotics intake on oral environment changes of the elderly in long-term care facilities

Journal of Korean Society of Dental Hygiene

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https://doi.org/10.13065/jksdh.20200069

ABSTRACT

Objectives: This study was aimed at evaluating the effects of changes in the oral environment of the elderly in long-term care facilities after the intake of *Weissella cibaria*. **Methods:** The test group ingested the *W. cibaria* strai Chonnam Medical University (CMU), and the control group ingested the control food. Of all randomized trial subjects 62 were analyzed (32 in the experimental group and 30 in the control group). In this 8-week demographic study, we evaluated self-perceived halitosis, changes in halitosis, sensory test results, tongue plaque index scores, saliva buffering capacity, and the salivary flow rate. **Results:** The *W. cibaria* CMU intake in the elderly in long-term care facilities during the experimental period did not demonstrate statistically significant changes in the salivary flow rate. However, self-perceived halitosis, organoleptic test results, tongue plaque index scores, and salivary buffering capacity demonstrated statistically significant differences between the experimental and control groups. These findings partially confirmed the beneficial effects of the *W. cibaria* CMU on the oral environment in the elderly. **Conclusions:** Research results on the role of probiotics in the oral cavity should be summarized, and utilization plan should be sought to obtain a clearer understanding of the clinical efficacy and related factors. The value of probiotic use may be high in improving the oral health of people by enabling treatment and prevention.

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Reference	Design	Subjects	Dose & Duration
Han H.S., et al., 2023	Randomized, double-blind, placebo-controlled	100 adults (20-70 yrs) with halitosis	100 mill CFU for 8 weeks Dissolved in mouth after brushing teeth before bed
Jo S.R., et al. 2020		100 adults (20-70 yrs) with halitosis	
Lee D.S., et al.., 2021		62 college students (20 yrs) with total VSC ≥1.5 ng/10 mL	
Kang M.S., et al., 2021		68 college students > 20 yrs	
Kang M.S., et al., 2020		92 adults (20-39 yrs) with total VSC ≥1.5 ng/10 mL	
Kim D.H., et al., 2020		60 adults (20-70 yrs) with total VSC ≥1.5 ng/10 mL	
Lee D.S., et al., 2020		92 adults (20-39 yrs) with total VSC ≥1.5 ng/10 mL	

Same designs…
just different subject demographics (# and age)

- ***F. nucleatum*** was significantly lowered from week 4-8 and ***S. aureas*** by week 8 vs. placebo (Kang M.S., 2020)
- ***S. mutans*** was significantly reduced vs. placebo at 4 weeks and 4 weeks after stopping supplementation (Park H.R., 2020)
- Those with a high cavity risk had an improvement in cariview score from **32.4% at baseline to 8.8%** at week 8 (Kang M.S., 2021)

Outcome	Supporting Studies
✅ **Reduces Volatile Sulfur Compounds (VSCs)**	Han H.S. (2023), Jo S.R. (2020), Lee D.S. (2020), Kang M.S. (2006)
✅ **Improves Self-Reported Bad Breath**	Han H.S. (2023), Jo S.R. (2020), Lee D.S. (2021), Kim D.H. (2020), Lee D.S. (2020)
✅ **Improves Breath Rating by Examiners (10 cm)**	Kim D.H. (2020), Lee D.S. (2020)
✅ **Increases Colonization of *W. cibaria***	Lee D.S. (2020), Park H.R. (2020)
✅ **Reduces Harmful Oral Bacteria**	Kang M.S. (2020), Park H.R. (2020), Kang M.S. (2006), In vitro (2006)
✅ **Improves Oral Health Markers (plaque, caries risk)**	Kang M.S. (2021), Park H.R. (2020)
✅ **Enhances Quality of Life Related to Oral Health**	Lee D.S. (2021)

OraCMU™ Clinical Results

- Total VSCs significantly lower in OraCMU™ vs. placebo at 8 weeks, and decreasing trend in second study (**2 clinical studies**)
- VSCs significantly reduced with OraCMU™ vs. placebo in 4 weeks
- VSCs decreased by 48-59% (*gargling*)
- Bad breath scores (self-evaluated) significantly improved with OraCMU™ vs. placebo (in as little as 4 weeks in one study) (**5 clinical studies**)
- Sensory evaluation test (trained examiner recorded odor at a distance of 10 cm) showed OraCMU™ had significantly better scores vs. placebo (**3 clinical studies**)
- Tongue plaque scores significantly improved with OraCMU™ vs. placebo
- Quality of life related to oral health significantly improved with OraCMU™ vs. placebo
- Cariview score (predicts incidence of cavities by measuring acid production of oral bacteria) significantly decreased in subjects at high risk of cavities (32.4% to 8.8% in 8 weeks)
- *F. nucleatum* was significantly reduced in the OraCMU™ group vs. placebo in 4 weeks and remained significantly lowered at 8 weeks
- *S. aureus* was significantly reduced in the OraCMU™ group vs. placebo at 8 weeks
- *S. mutans* was significantly reduced in the OraCMU™ group vs. placebo (and persisted after supplementation ceased)
- OraCMU™ demonstrated effective colonization of the oral cavity at weeks 4 and 8, OraCMU™ colonization increased after 4 weeks and was maintained over 50% after supplementation ceased (**2 clinical studies**)

OraCMU™ Clinical Summary

9 Total Clinical Trials

- **7** clinical trials with an 8-week, randomized, double-blind, placebo-controlled protocol
  - Populations:
    - 344 adults (160 20-70 yrs, 184 20-39 yrs) with halitosis (VSCs ≥ 1.5 ng/10 mL)
    - 62 older adults (>65) living in long-term care
    - 62 college students (20) with halitosis (VSCs ≥ 1.5 ng/10 mL)
    - 68 college students (>20)
  - Dose: 100 million CFU OraCMU™ daily (tablet in 5 trials, powder in 2 trials) dissolve in mouth before bed after brushing teeth
- **One** 4-week randomized, double-blind placebo-controlled study
  - 50 adults
- **One** two-part discovery trial (Part I was isolating OraCMU™ from oral cavities of healthy Korean kindergarteners – OraCMU™ produced the most hydrogen peroxide; Part II tested 46 dental students gargling with OraCMU™ for 2 mins twice daily)

OraCMU™ Human Oral Health Claims

- Supports fresh breath
- Helps minimize the formation of odorous gases linked to bad breath
- Helps reduce malodorous gases created by bacteria
- Supports fresh breath by targeting bacteria associated with breath odor
- Supports fresh breath by helping maintain a balanced oral microbiome
- Promotes a healthy balance of oral bacteria
- Helps maintain overall oral health
- Naturally produces hydrogen peroxide, which helps whiten teeth

Dosage and Use	
Dissolve one lozenge in mouth daily, preferably after brushing teeth.	
Supplement Facts	
Serving Size 1 Vegetarian Lozenge	
Amount Per Serving	
OraCMU™ *Weissella cibaria* CMU (providing 4 B CFU*)	40 mg
Allergens: Dairy	

*We recommend **a minimum of 4B Colony Forming Units (CFU) at time of manufacture to guarantee an effective 100M CFU ORACMU through shelf life**. It is up to the customer to determine the level of overage that will guarantee an effective dose at end of shelf life, as many variables (manufacturing, packaging, other ingredients) may alter live probiotic viability.

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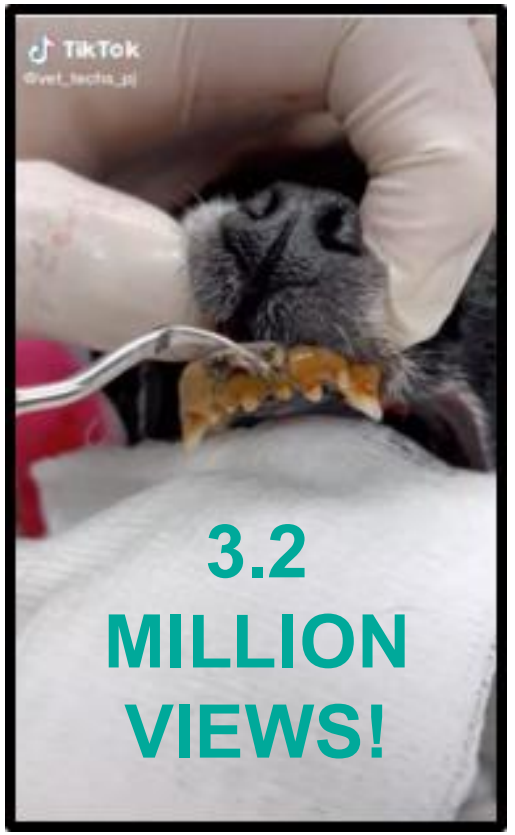
Current Treatments

- **Brushing** *(many dogs do not make brushing easy)*
  - More than half of pet owners state brushing their pet's teeth is too difficult (Loop Global overview survey, 2024)
  - Owners of dogs *with* serious dental issues tend to follow dental care recommendations better…(but) preventative care is still inadequate for more than half the dogs
- **Many rely on alternatives**
  - Dental chews
  - Hard chew toys
  - Specialized diet
  - Probiotics (mainly focused on digestive issues that can cause breath odor)
- **Dental scaling requiring anesthesia when build-up is severe (*average* cost $300)**
- **Anti-bacterial toothpastes and disinfectants take out good bacteria with the bad**



Oral malodor-reducing effects by oral feeding of *Weissella cibaria* CMU in Beagle dogs

Kyung-Hyo Do[1], Ho-Eun Park[1], Mi-Sun Kang[2], Jong-Tae Kim[2], Ji-Eun Yeu[1], Wan-Kyu Lee[1]*

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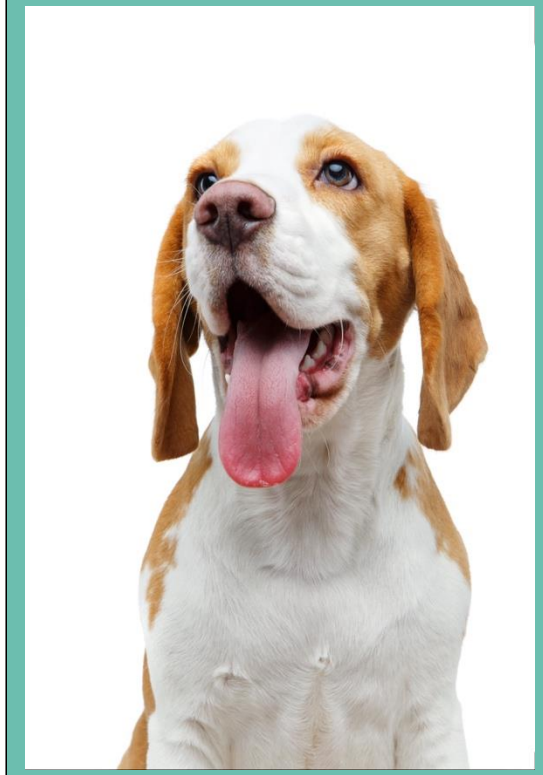
Abstract: This study assessed the effects of *Weissella cibaria (W. cibaria*) CMU on oral health in male and female beagles (n = 18) by measuring oral malodor and periodontal disease-related parameters (calculus, plaque, and gingivitis indices). Oral malodor and indicators of periodontal disease were assessed in five treatment groups: negative control (scaling and 0.24 mg of maltodextrin, n = 3), positive control (0.24 mg of maltodextrin, n = 3), and *W. cibaria* CMU groups (each n = 4) at low (CMU-L, 2×10^7 colony forming unit [CFU]), medium (CMU-M, 2×10^8 CFU), and high (CMU-H, 2×10^9 CFU) concentrations. After feeding with *W. cibaria* CMU for 6 weeks, total volatile sulfur compound concentrations in the CMU-L (2.0 ± 1.04 ng/10 mL), CMU-M (2.4 ± 1.05 ng/10 mL), and CMU-H (2.6 ± 1.33 ng/10 mL) groups were significantly lower than in the positive control group (3.2 ± 1.65 ng/10 mL). Also, CMU-L (1.4 ± 0.83 ng/ 10 mL) and CMU-H (1.9 ± 1.14 ng/10 mL) groups had methyl mercaptan levels lower than that in the positive control group (2.4 ± 1.21 ng/10 mL) at week 2. The plaque index was significantly lower in the CMU-H group (4.5 ± 0.28) than in the positive control group (5.9 ± 1.08) at week 6. *W. cibaria* CMU could be useful as a novel oral hygiene probiotics for reducing volatile sulfur compounds production and inhibiting plaque growth in companion animals.

Keywords: Beagle, *Weissella cibaria* CMU, methyl mercaptan, oral malodor, plaque index

****Introduction****

Oral malodor, commonly referred to as bad breath, is an unpleasant odor coming from the mouth or nose [23]. In companion animals, malodor can negatively affect the relationship between the pet and the owner, as it is often a source of discomfort for the owner. From a veterinary perspective, malodor can be an indicator of systemic or oral diseases, making it an important diagnostic marker.

Oral malodor originates from the oral cavity, nasal passages, upper respiratory tract, and upper digestive tract, with approximately 90% attributed to oral causes [27]. When systemic diseases



Original Study

Journal of Veterinary Dentistry
2019, Vol. 36(2) 135-142

DOI: 10.1177/0898756419872562
journals.sagepub.com/home/jov
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Effects of *Weissella cibaria* CMU on Halitosis and Calculus, Plaque, and Gingivitis Indices in Beagles

Kyung-Hyo Do, DVM, MSc[1], Ho-Eun Park, PhD[1], Mi-Sun Kang, PhD[2], Jong-Tae Kim, MSc[2], Ji-Eun Yeu, MSc[2], and Wan-Kyu Lee, DVM, PhD[1]

Abstract

Weissella (W.) cibaria strain Chonnam Medical University (CMU) has shown oral colonizing ability and inhibitory effects on the formation of volatile sulfur compounds (VSCs) *in vitro* studies. The present study was conducted to analyze the effects of the *W. cibaria* CMU on canine oral health. Halitosis, calculus, plaque, gingivitis, and intraoral microbiota were assessed in 3 groups: control (maltodextrin), *W. cibaria* CMU low concentration (CMU-L, 2×10^7 colony forming unit [CFU]), and high-concentration (CMU-H, 2×10^9 CFU). Halitosis was analyzed using both organoleptic evaluation and measurement of VSCs. Intraoral microbiota were analyzed by real-time polymerase chain reaction. From week 4, the total VSC level in the CMU-H group (4.0 ± 1.30 ng/10 mL) was significantly lower than in the control group (6.3 ± 2.28 ng/10 mL). Significant reduction in methyl mercaptan in the CMU-treated groups was also observed. In addition, the plaque index in the CMU-treated groups was significantly decreased. The CMU-treated groups showed significant decreases in *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Tannerella forsythia* and demonstrated the colonizing ability of *W. cibaria* CMU in the oral cavity. We demonstrated that *W. cibaria* CMU suppresses halitosis, colonizes the oral cavity, and inhibits the proliferation of malodor-causing oral bacteria in beagles. According to these results, we expect that *W. cibaria* CMU could be a new oral hygiene solution by reducing VSC production and inhibiting the growth of oral harmful bacteria in companion animals.

Keywords

halitosis, *Weissella cibaria* CMU, methyl mercaptan, plaque index, beagle

Introduction

Halitosis refers to an unpleasant smell from the oral cavity. Due to the nature of the disease, much research has been done on the diagnosis and treatment of halitosis, mostly in humans.[1] From a veterinary perspective, the fact that animals can also develop halitosis is important as a useful sign in the diagnosis of systemic and oral diseases. If systemic disease is excluded, halitosis is usually due to the intraoral environment.[2,3]

Halitosis of oral etiology is caused by the production of volatile compounds that produce a smell when they react with the proteins or peptides contained in food or saliva. In particular, the major compounds known to cause halitosis include the sulfur-containing amino acids cysteine and methionine and the sulfur-containing compounds methyl mercaptan (CH_3SH), hydrogen sulfide (H_2S), and dimethyl sulfide ($[(CH_3)_2S]$).[4]

Severe halitosis can also occur in individuals with periodontal disease. Clinically, periodontal disease presents with gingival bleeding, swelling, periodontal pockets, and destruction of the periodontium. One of the major causes of periodontal disease is the accumulation of packed material within the periodontal pocket.[5] This becomes a habitat for intraoral bacteria that proliferate and produce the sulfurous compounds described above, resulting in halitosis. Of the many intraoral bacteria, *Aggregatibacter (A.) actinomycetemcomitans* is associated with localized aggressive periodontitis, while *Porphyromoans (P.) gingivalis*, *Tannerella (T.) forsythia*, *Treponema denticola*, and *Fusobacterium (F.) nucleatum* also play important roles in periodontal disease and oral malodor.[6]

Management of oral disease and halitosis requires diagnosis by a veterinarian followed by comprehensive anesthetic examination, professional cleaning, and appropriate home care.[7] Consistent home oral hygiene such as toothbrushing can be challenging for some patients or pet owner. Although

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Do KH, et al. **Oral malodor-reducing effects by oral feeding of *Weisella cibaria* CMU in beagle dogs.** *Korean Journal of Veterinary Research*. 2018;58(2):87-94.

- **6-week, placebo-controlled study**
- **18 healthy female and male beagles, aged 1-3 years, weighing 9.8±2.18 kg, commercial dog diet**
- **Three experimental groups:**
  - Positive control (PC) = Placebo (maltodextrin placebo)
  - Negative control (NC) = Scaling + Placebo (dental scaling done one week before experiment, maltodextrin placebo)
  - **Treatment with OraCMU™, powder form, maltodextrin carrier, three different doses**
    - Low: “CMU-L” = 20M CFU OraCMU™
    - Medium: “CMU-M” = 200M CFU OraCMU™
    - High: “CMU-H” = 2 B CFU OraCMU™
- **Treatment and placebo powders were mixed with 2 mL of phosphate-buffered saline and then immediately administered orally via syringe once daily**

Do KH, et al. **Oral malodor-reducing effects by oral feeding of *Weisella cibaria* CMU in beagle dogs.** *Korean Journal of Veterinary Research*. 2018;58(2):87-94.

- **Organoleptic Evaluation ("Sniff Test")**
  - Trained examiner assessed and scored breath odor 2 cm distance from dog's mouth.
- **Measurement of VSCs**
  - Air collected from the oral cavity via syringe is measured using a portable gas chromatograph (OralChroma CHM-2), which detects hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and total VSC concentrations
- **Measurement of Clinical Indicators**
  - Calculus
  - Plaque
  - Gingivitis Index

Halitosis reducing effect of Weissella cibaria CMU in beagle dogs 89

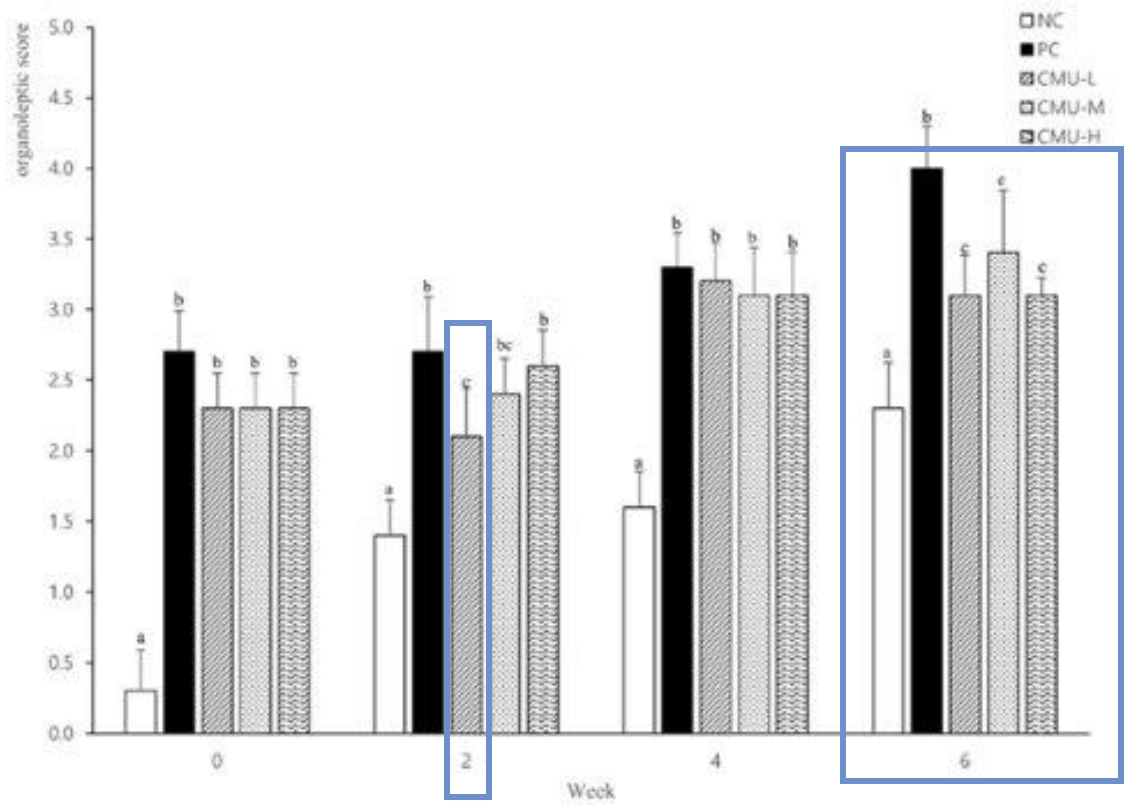


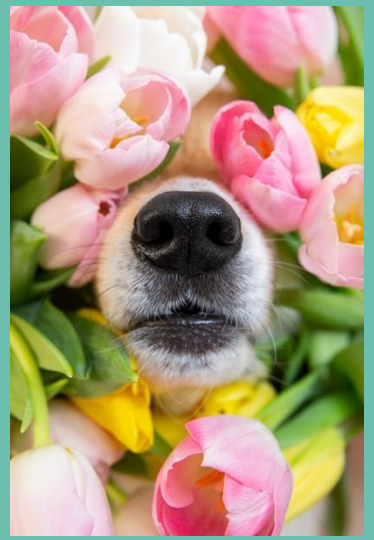
Fig. 1. The organoleptic scores in beagle dogs after consumption of a *Weissella cibaria* CMU. Data represents the mean ± SD. Different superscript letters (a, b, and c) indicate the statistical differences determined by ANOVA ($p < 0.05$). Negative control (NC) group's teeth were scaled before experiment. NC and positive control (PC) groups were fed maltodextrin 2.4×10^{-4} g, daily. CMU-L group were fed *W. cibaria* CMU 2.0×10^{7} CFU, daily. CMU-M group were fed *W. cibaria* CMU 2.0×10^{8} CFU, daily. CMU-H group were fed *W. cibaria* CMU 2.0×10^{9} CFU, daily. CFU, colony-forming unit.

Organoleptic/Sensory Results:

- NC = scaling + placebo
- PC = placebo

Results:

- At week 2, the organoleptic index of the **20M CFU OraCMU™** group was significantly lower vs. placebo
- **By week 6, all doses had significantly better breath scores vs. placebo**



VSC Measure Results:

- In as little as **two weeks**, **all OraCMU™ groups** had significant reductions in total VSCs vs. placebo
- Significant reduction in total VSCs vs. placebo was sustained through end of study

Table 1. Concentrations of total volatile sulfur compounds in beagle dogs after consumption of *Weissella cibaria* CMU

Group	Week			
	0	2	4	6
NC	0.2 ± 0.16^{a}	1.1 ± 0.58^{a}	1.6 ± 0.92^{a}	1.8 ± 1.02^{a}
PC	2.2 ± 0.72^{b}	3.2 ± 1.65^{b}	4.1 ± 1.78^{b}	4.0 ± 2.29^{b}
CMU-L	2.1 ± 1.30^{b}	2.0 ± 1.04^{c}	2.7 ± 0.80^{c}	1.6 ± 1.03^{a}
CMU-M	2.2 ± 1.36^{b}	2.4 ± 1.05^{cd}	2.2 ± 1.20^{c}	2.5 ± 1.29^{c}
CMU-H	2.2 ± 1.72^{b}	2.6 ± 1.33^{d}	2.3 ± 1.31^{c}	2.0 ± 1.30^{ac}

The values are expressed as mean ± SD in ng/10 mL. Different superscript letters indicate the statistical differences determined by ANOVA ($p < 0.05$). NC, negative control; PC, positive control.

Table 3. Concentrations of methyl mercaptan (CH_3SH) in beagle dogs after consumption of *Weissella cibaria* CMU

Group	Week			
	0	2	4	6
NC	0.1 ± 0.13^{a}	0.4 ± 0.40^{a}	0.4 ± 0.43^{a}	0.6 ± 0.51^{a}
PC	1.5 ± 0.84^{b}	2.4 ± 1.21^{b}	3.1 ± 1.64^{b}	2.6 ± 1.82^{b}
CMU-L	1.4 ± 1.28^{b}	1.4 ± 0.83^{c}	1.8 ± 0.79^{c}	0.8 ± 0.69^{ac}
CMU-M	1.8 ± 1.04^{b}	1.9 ± 1.05^{d}	1.5 ± 0.96^{c}	1.5 ± 1.24^{d}
CMU-H	1.6 ± 1.26^{b}	1.9 ± 1.14^{d}	1.5 ± 1.04^{c}	1.1 ± 0.89^{cd}

The values are expressed as mean ± SD in ng/10 mL. Different superscript letters indicate the statistical differences determined by ANOVA ($p < 0.05$).

- In only **two weeks**, **all OraCMU™ groups** also showed significant reductions in methyl mercaptan vs. placebo
- Significant reduction in methyl mercaptan vs. placebo was sustained through end of study

Clinical Indicator Results:

- At week 6, **2B CFU OraCMU™** showed **significant reduction in plaque index** vs. placebo

Table 6. Plaque index in beagle dogs after consumption of *Weissella cibaria* CMU

Group	Week			
	0	2	4	6
NC	1.9 ± 1.26^{a}	2.7 ± 0.18^{a}	3.0 ± 0.73^{a}	3.8 ± 1.08^{a}
PC	4.4 ± 0.46^{b}	4.7 ± 0.63^{b}	4.8 ± 0.57^{a}	5.9 ± 1.08^{c}
CMU-L	3.6 ± 0.60^{ab}	3.2 ± 0.77^{ab}	3.9 ± 0.75^{a}	5.3 ± 0.78^{bc}
CMU-M	3.5 ± 0.12^{ab}	3.2 ± 0.25^{ab}	3.9 ± 0.20^{a}	5.2 ± 0.83^{abc}
CMU-H	4.3 ± 0.52^{ab}	3.3 ± 0.30^{ab}	4.1 ± 0.19^{a}	4.5 ± 0.28^{ab}

The values are expressed as mean ± SD. Different superscript letters indicate the statistical differences determined by ANOVA ($p < 0.05$).

Do KH, et al. **Effects of *Weissella cibaria* CMU on Halitosis and Calculus, Plaque, and Gingivitis Indices in Beagles.** *Journal of Veterinary Dentistry*. 2019;36(2):135-142.

- *6-week, placebo-controlled study*
- *18 healthy female and male beagles, aged 1-3 years, weighing 9.8±2.18 kg, commercial dog diet*
- **All dogs received professional dental scaling 1 week prior to the start of the trial**
- **Three experimental groups:**
  - Positive control (PC) = Placebo (maltodextrin)
  - **Treatment with OraCMU™, powder form, maltodextrin carrier:**
    - Low: "CMU-L" = 20M CFU OraCMU™
    - High: "CMU-H" = 2 B CFU OraCMU™
- *Treatment and placebo powders were mixed with 2 mL of phosphate-buffered saline and then immediately administered orally via syringe once daily*

Do KH, et al. **Effects of *Weissella cibaria* CMU on Halitosis and Calculus, Plaque, and Gingivitis Indices in Beagles.** *Journal of Veterinary Dentistry*. 2019;36(2):135-142.

- ***Organoleptic Evaluation ("Sniff Test")***
  - *Trained examiner assessed and scored breath odor 2 cm distance from dog's mouth.*
- ***Measurement of VSCs***
  - *Air collected from the oral cavity via syringe is measured using a portable gas chromatograph (OralChroma CHM-2), which detects hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and total VSC concentrations.*
- ***Measurement of Clinical Indicators***
  - *Calculus*
  - *Plaque*
  - *Gingivitis index*
- ***Oral Bacterial Analysis - Colonization***
  - OraCMU™
  - 5 periodontal pathogens: *A. actinomycetemcomitans*, *F. nucleatum*, *P. gingivalis*, *Prevotella (Pr.) intermedia*, and *T. forsythia*)
  - 2 cariogens: *S. mutans* and *S. sobrinus*

Table 5. Organoleptic Scores (Mean ± Standard Deviation) in Beagles After Treatment of *Weissella Cibaria* CMU.

	Week			
Group	0	2	4	6
Control	3.0 ± 0.43[1]	3.4 ± 0.51[1]	3.5 ± 0.67[1]	3.7 ± 0.49[1]
CMU-L	2.9 ± 0.51[1]	3.0 ± 0.60[1,2]	2.8 ± 0.39[2]	2.8 ± 0.58[2]
CMU-H	2.8 ± 0.87[1]	2.8 ± 0.62[2]	2.3 ± 0.45[3]	2.2 ± 0.39[3]

Abbreviations: ANOVA, analysis of variance; CMU, Chonnam Medical University.

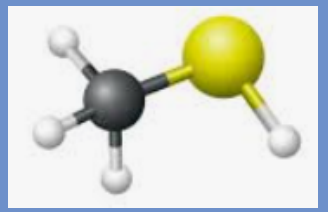
[a]Different superscript numbers (1, 2, 3) indicate the statistical differences determined by ANOVA ($P < .05$). CMU-H = 2×10^9 CFU. CMU-L = 2×10^7 CFU.

Organoleptic Evaluation:

Results:

- 2 weeks: **2B CFU** OraCMU™ had **significantly better breath scores vs. placebo,** and this remained significant through 6 weeks

- 4 weeks: **20M CFU** OraCMU™ had **significantly better breath scores vs. placebo**, and remained significant through 6 weeks

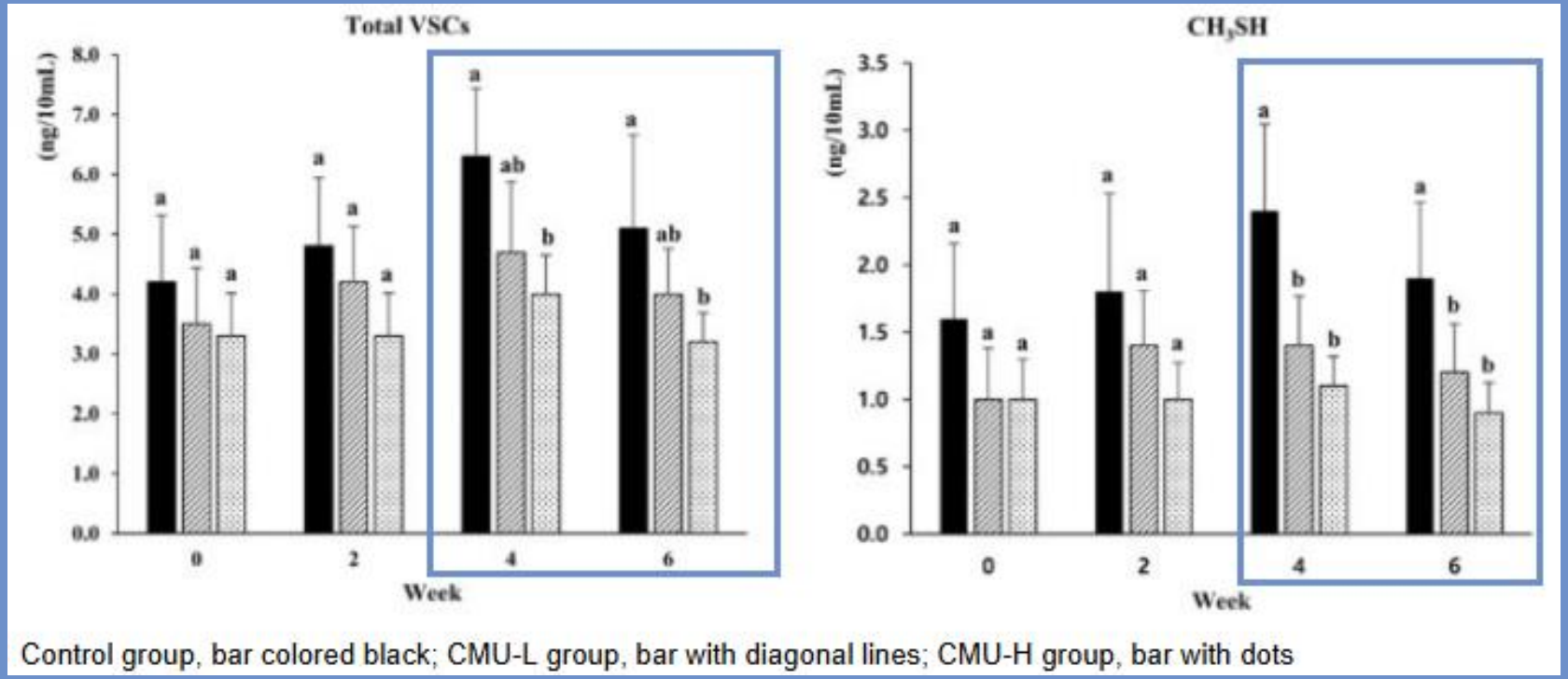


Measurement of VSCs:

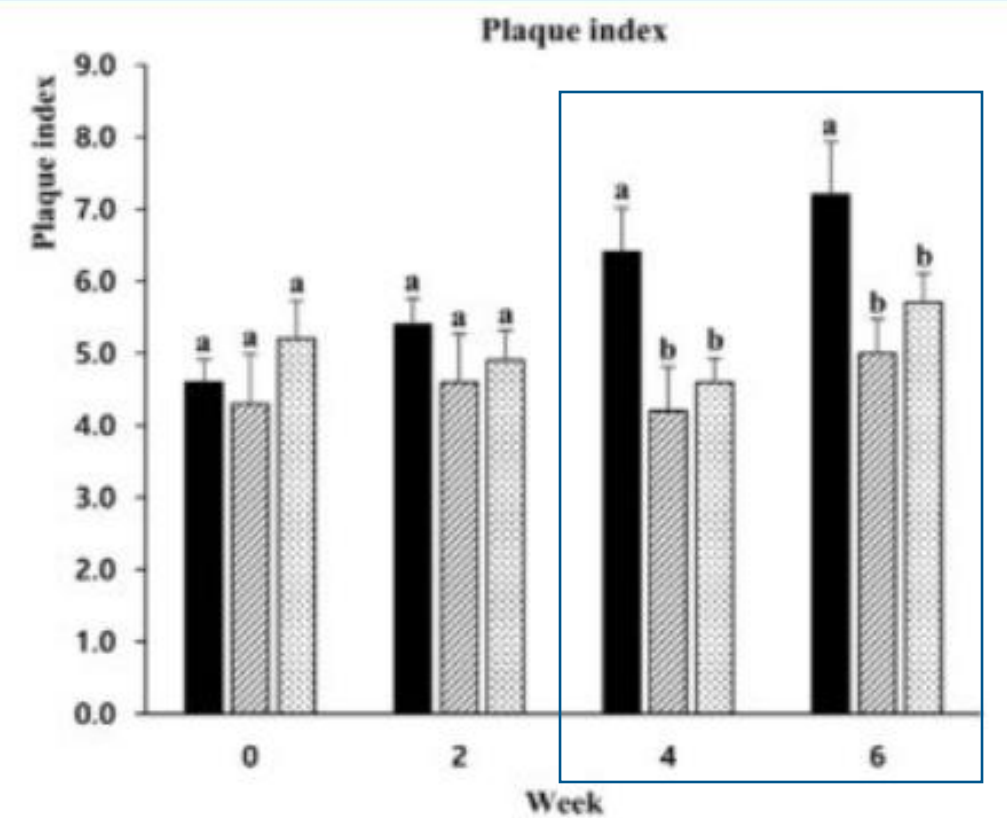
- 4 weeks: **2B CFU OraCMU™** had significantly **lower total VSC concentration** vs. placebo, and remained significant through 6 weeks

Methyl Mercaptan:

- 4 weeks, **20M and 2B CFU OraCMU™ had significantly reduced methyl mercaptan levels** vs. placebo and this was sustained through 6 weeks



Control group, bar colored black; CMU-L group, bar with diagonal lines; CMU-H group, bar with dots



Control group, bar colored black; CMU-L group, bar with diagonal lines; CMU-H group, bar with dots

Clinical Indicators Results:

- The placebo group (post-scaling) showed persistently increasing plaque index
  - **20M** and **2B CFU** OraCMU™ **maintained similar values as the start** of the experiment (just after dental scaling)

- Week 4: **20M** and **2B CFU** OraCMU™ had **significantly lower plaque index score** vs. placebo

Table 6. Mean Log_{10} DNA Copy ± SD Values for Bacterial Counts of Dental and Supragingival Swab Samples After Treatment of *Weissella Cibaria* CMU.

		Mean Log_{10} DNA Copy ± SD		
Bacteria	Week	Control	CMU-L	CMU-H
Fusobacterium Nucleatum	0	4.3 ± 0.26[1,2]	4.6 ± 0.13[1]	4.2 ± 0.25[2]
	2	4.6 ± 0.25[1]	4.4 ± 0.23[1]	4.4 ± 0.27[1]
	4	4.4 ± 0.16[1]	3.9 ± 0.46[1]	4.0 ± 0.60[1]
	6	4.5 ± 0.26[1]	4.1 ± 0.42[2]	4.0 ± 0.24[2,3]
Porphyromonas Gingivalis	0	4.8 ± 0.27[1]	5.0 ± 0.28[1]	4.6 ± 0.51[1]
	2	5.0 ± 0.31[1]	4.5 ± 0.35[1,2]	3.8 ± 1.02[2,3]
	4	4.5 ± 0.34[1]	3.8 ± 0.66[2]	4.0 ± 0.42[1,2]
	6	4.4 ± 0.37[1]	3.8 ± 0.56[2]	3.8 ± 0.22[2,3]
Weissella cibaria	0	0.6 ± 1.37[1]	0.9 ± 1.46[1]	0.6 ± 0.77[1]
	2	0.5 ± 1.08[1]	0.6 ± 1.51[1]	0.5 ± 1.20[1]
	4	0.4 ± 0.58[1]	1.9 ± 1.56[1]	2.0 ± 1.70[1]
	6	0.6 ± 1.35[1]	2.4 ± 0.50[2]	0.7 ± 0.80[3]

Abbreviations: ANOVA, analysis of variance; CMU, Chonnam Medical University; SD, standard deviation.

[a]Different superscript numbers (1, 2, and 3) indicate the statistical differences determined by ANOVA ($P < .05$). CMU-H = 2×10^9 CFU. CMU-L = 2×10^7 CFU.

Oral Bacteria Analysis:

- 6 weeks: **20M and 2B CFU** OraCMU™ groups had **significantly lower levels of *F. nucleatum* and *P. gingivalis*** vs. placebo
- 6 weeks: **OraCMU™ levels were significantly higher in 20M and 20B CFU OraCMU™ groups** vs. placebo (demonstrating **effective colonization**)

OraCMU™ Pet Health Claims

- Researched in dogs, for dogs
- Supports fresh breath (helps reduce “doggy breath”)
- Targets bacteria associated with breath odor
- Helps reduce formation of odorous gas linked to bad breath
- Helps reduce bacterial production of malodorous gases
- Helps maintain a balanced oral microbiome
- Supports healthy teeth and gums by supporting a healthy oral microbiome
- Helps maintain overall oral health
- Helps reduce plaque naturally, less invasive than commonly used methods

Formulation Notes:

- Live probiotic needs to be kept away from heat and moisture
- OraCMU is room temperature stable
- The longer the oral cavity contact, the better

Dosage and Use
Sprinkle one scoop over dog food once daily.
Dissolve one scoop in treat paste and apply directly to teeth.
Mix powder and 2 mL of water in syringe and apply directly to teeth.
Supplement Facts
Serving Size 1 Scoop or 1 Sachet
Amount Per Serving
oraCMU™ *Weissella cibaria* CMU (providing 20M CFU*) 20 mg
Allergens: Dairy

* At time of manufacture dose of 2B CFU/20mg ensures viable and efficacious OraCMU™ dose of 20M CFU by product expiration and keeps dosing for canines within the researched range (there was no overage in the studies).

OraCMU™ stands out as the most well-researched and unique oral probiotic strain to support bad breath and reduce VSCs in humans and their canine pals.

Nine human clinical trials and two canine clinical trials support strong claims for better breath in weeks.

Cheers to less “dog breath” all around!

Thank you for your time and attention!!