Biochemical and Biophysical Models of Constipation and Diarrhea Caused by Incorrect Dose or Uneven Intake of Edible Oils (Fats)

Peer review status: No

Corresponding Author: Dr. Kang Cheng, Scientist, Biomedical InfoPhysics, Science Research Institute - United States of America

Submitting Author: Dr. Kang Cheng, Scientist, Biomedical InfoPhysics, Science Research Institute - United States of America

Other Authors: Dr. ChangHua Zou, Scientist, Biomedical Infophysics, Science Research Institute - United States of America

Article ID: WMC004676
Article Type: Research articles
Article URL: http://www.webmedcentral.com/article_view/4676
Subject Categories: GASTROENTEROLOGY
Keywords: desiccation (dehydration), lipid, hydrophilic, hydrophobic, nutrition, hemorrhoid, anal, fissure, colitis
How to cite the article: Cheng K, Zou C. Biochemical and Biophysical Models of Constipation and Diarrhea Caused by Incorrect Dose or Uneven Intake of Edible Oils (Fats). WebmedCentral GASTROENTEROLOGY 2014;5(8):WMC004676
Copyright: This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC-BY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Source(s) of Funding: self.
Competing Interests: None
Additional Files: MS word .doc file of the article
Biochemical and Biophysical Models of Constipation and Diarrhea Caused by Incorrect Dose or Uneven Intake of Edible Oils (Fats)

Author(s): Cheng K, Zou C

Abstract

Constipation is a global public health problem; it troubles male and female; it torments infants, children and adults. The prevalence of constipation afflicts older people (over 60 years of age) than younger adults. Even animals also suffer from constipation.

Many prescription and nonprescription medications have been developed to cure constipation. However, most patients are unsatisfied with the treatment results.

On the other hand, mechanisms of constipation are unclear and probably multiple factorial.

In this article, we propound our biochemical and biophysical models to elucidate the special mechanism of constipation and diarrhea caused by incorrect dose or uneven intake of edible oils (fats) in human daily diets.

Based on our models, we develop methods (recipes) and present a minor preliminary clinic trial. Our methods are nutrition treatments to manage the constipation and diarrhea by adjusting the dose and evening the intake of the edible oils (fats) in human daily diets. To sufficiently and evenly consume edible oils could serve as protection factors against the development of constipation and diarrhea. Our methods are very safe and economical and can be accomplished in common family kitchens. Our tentative clinic data, using our methods, seem effective and supportive to our models.

Based on our models, methods and experimental results, we also propose a formula to semi quantitatively describe a relationship between the dose of the edible oils (fats) in the meal and the quantity of water in the correspondent defecation.

Although, in this investigation, we specially focus on modeling and providing treatment methods for constipation and diarrhea caused by incorrect dose or uneven intake of edible oils (fats) in human daily diets, we believe our models and methods are generally helpful to mechanical approaches and to medical and veterinary managements of hemorrhoids or colitis as well as constipation and diarrhea.

Introduction

Constipation is characterized by necessarily hard stools and by the presence of at least one of the following characteristics: painful stools or difficult stool passage, scybalous stools, cylindrical stools with cracks or thick cylindrical stools, or interval between bowel movements greater than or equal to three days [1]. Other definitions or symptoms [2–4] of constipation are similar to the above, but the more details are elucidated.

Constipation is a worldwide public health problem in both developed and developing countries [5 – 6]. Constipation torments infants [1, 7], children [8] and women [9]. The prevalence of constipation afflicts older people (over 60 years of age) than younger adults [3, 4, 6, 7, 10].

Statistically, constipation affects 2% to 27% of the adult population [2, 11 – 12]. In North America, the most estimates of the prevalence of constipation range from 12% to 19% [6, 7]. Constipation affects 15% of the US population [13].

Additionally, animals suffer from constipation too [14]. Consequently, a wide variety of prescription and nonprescription medications is available for constipation, encompassing a diverse range of therapeutic targets and mechanisms of action [2].

Traditional treatments include osmotic laxatives, stimulant laxatives, prokinetic agents, biofeedback training, and surgery [4, 13, 15 – 16].

Nevertheless, half of patients remain unsatisfied with available treatment options [17] thereby highlighting the continued therapeutic gap in this patient population [2]; these treatments often are tried sequentially and episodically, with little evidence of long-term efficacy [13, 18]; a summary of the evidence review group (ERG) report into the clinical effectiveness and cost-effectiveness of prucalopride for the treatment of women with chronic constipation in whom standard laxative regimens have failed to provide adequate relief [9]; these drugs are not so ideal in clinical use because of their potentially adverse side effects such as inducing tolerance, melanosis coli, or cathartic...
colon [7, 19]. Therefore, increasing fibers ingestion including dietary or medicinal fibers has been well accepted to be a primary treatment modality to relieve symptoms, especial for mild complaints of infrequency or hard stools [7, 19].

However, a clinic study showed that the estimated intake of dietary fiber was not different between constipated and nonconstipated infants. With respect to natural breastfeeding, it was affirmed that its protective role against constipation in the first six months of life is one more advantage in relation to artificial breastfeeding [1].

In a word, mechanisms of constipation are unclear and remain challenges for today’s gastroenterologists [13]. The pathophysiology of constipation is poorly understood and likely multifactorial [2, 20]. The etiopathogenesis of chronic functional constipation in infants is not fully known [1].

In this article, we focus on modeling constipation and diarrhea caused by incorrect dose or uneven intake of edible oils (fats) in human daily diets. Based on our models, we provide treatment methods to manage the constipation and diarrhea and present a minor clinic trial to support our models.

Methods

2.1 Methods of Models

Our models are based on published biomedical, biochemical and biophysical data [1 - 27] and theories of biochemistry [28], biomechanics [29] and biomedical infophysics [30].

2.2 Methods of Experiments

Human has some major metabolisms of nutrition: carbohydrates, fats or oils, proteins and dietary fibers [28, 31].

One person usually needs 1600 to 2800 calories per day [31]. For general health and better weight control, people should distribute calories evenly through out the day: carbohydrates (55 – 65 %), fats or oils (20 - 30 %), proteins (12 – 15 %), and dietary fibers (20 – 35 grams) [31, 32].

Usually, a high protein diet is typically high in fats [31], such as red meats, there are always some fats (5 – 20 %) in the meats, some proteins and fats have already naturally and organically mixed together.

Animal fats contain more saturated and trans fats than plant edible oils; and saturated and trans fats increase the risk of cardiovascular diseases. Therefore, people are suggested to mostly consume plant cooking oils, such as olive oil, peanut oil, corn oil, sesame oil, canola oil or vegetable oil rather than animal fats [28, 31 – 32].

To prevent the constipation and diarrhea, in this investigation, we develop our methods (recipes of soups) to evenly distribute plant cooking oils into carbohydrates, proteins and fibers in human daily diets.

Daily major cooking materials or foods: (2000 – 2500 calorie diets per day) [31].

- Plant cooking oils: 50 – 70 grams (55 – 75 ml) per person.
  - Fresh red meats, poultries, shrimps, scallops or fishes [for carnivores only]: 0 – 50 grams per person.
  - Fresh bones: 50 – 200 grams per person [for carnivores only].
  - Fresh vegetables and fruits: at least 3 different vegetables (600 – 1000 grams), 2 different fruits (200 – 300 grams).
  - Eggs: 1 – 2, but half yolk.
  - Legumes: 10 – 50 grams per person.
  - Cooked carbohydrate foods (ready to eat):

Boiled noodle or (steamed) bread or rice: 300 – 500 grams (dry weights).

Recipes of boiling soups for carnivores:

1. Cut off fats and/or skins from the cleaned fresh meats (or poultries) as much as possible. But, retain bones to supply calcium. This fat cut-off is the first process of de-fat or degrease and is often used in some Chinese restaurants.
2. To remove extra fats and dirty materials, put the meats (or poultries) and bones in a cooking pot (boiler) and merge them in clean water; heat the meats (or poultries) and water at high heat until the water is boiling; then maintain the boiling at a low heat for 5 -10 minutes.
3. Take the meats (or poultries) and bones out of the fatty and dirty boiled water and wash them with clean water at least three times. Again, cut off fats and/or skins from the boiled meats (or poultries) and bones as much as possible. This water pre-boiling is the second process of de-fat (or degrease) and is often used in some Chinese restaurants.
4. Put the boiled and washed meats (or poultries) and bones in a clean pot with clean water (half liter per person); heat them at high heat until the water is boiling; then maintain the boiling until the meats (or poultries) are well done.
5. When the meats (or poultries) are well done, remove extra animal oils from the soup surface if the
floating oils are too many. This surfacial removing of fats is the third process of degrease (or de-fat) and is also often used in some Chinese restaurants. If the soup is too little, add more clean water to ensure 300 – 500 ml soup per person.

6. Add some salt; 200 – 300 grams (per person) of cleaned fresh vegetables; 0 – 25 ml (per person) plant cooking oils into the soup; and continue to boil the soup for at least 5 seconds. The dose of the plant cooking oil is inversely proportional to the amount of animal oil in the soup. This dose, more or less, also depends on the last correspondent defecating results: constipation or diarrhea. Practice many times to obtain the correct dose of the plant cooking oils for an individual person.

7. Remove the bones from the soup if possible. Evenly mix the soup, including the meats (or poultries) and vegetables, and steamed rice or boiled needle together. The temperature of eating foods is 30 - 40°C.

If taking remained rice from the last meal, at the step 7 of the recipe, boil the evenly mixed (semi liquid and semi solid) soup, including the meats (or poultries) and vegetables, and rice with a low heat for at least 1 minute, then maintain the cooked food in the pot (covered with the cap) for at least 15 minutes.

If consume a soup of fishes, shrimps, scallops, eggs or legumes (for vegetarian), start from step 4 with them; then follow the procedures (recipes are similar to the above).

If eating (steamed) breads, crackers, pies, pancakes, light fried vegetables, eggs, red meats, poultries or fishes, eat the foods and drink a cooking oil soup simultaneously.

Use of drugs was associated with constipation and diarrhoea in the general population. The associations are most likely adverse drug reactions and show that drug-induced symptoms need to be considered in subjects with these complaints [33]. Pharmacological treatment with nitrates and antithrombotics may represent an independent risk factor for developing constipation [34].

Therefore, to avoid taking any vitamins, calcium, or other medicine tablets, based on published nutrition data [31 – 32], we suggest to consume at least 3 different vegetables (600 - 1200 grams) and 2 different fruits (200 - 300 grams), and bone soups (for carnivores only, boil bones about 1 - 2 hours with low heat), daily. If has to take some antioxidant vitamins to block cell damages caused by free radicals [31] (e.g., for wound healing), add more 3 - 6 ml plant cooking oils per tablet, to balance the desiccative effects caused by the medicines; and the optimum time to take the medicine tablets is the dieting time to prevent constipation.

**Participants:**
A clinical trial with two subjects and with our recipes was performed, based on our models, for 24 months from August 2012 to July 2014. The two people were in their middle ages, with chronic constipation, living in private households in New Jersey, USA. All participants took 3 common meals, normal sodium and water [24, 31 – 32] daily.

**Interventions:**
Prescription and nonprescription laxatives were taken by one subject for couple of days.

**Outcome measures:**
According to feeling of abdominal pain, anal pain, rectal pain; observing of blooding feces, when defecating stools, referenced Scoring Systems in Evaluation of Constipation and Obstructed Defecation Syndrome (ODS) [35] and Patient Assessment of Constipation-Symptoms (PAC-SYM)/Patient Assessment [10], we define five levels of self assessments of pain: (1) no, (2) mild, (3) common, (4) severe and (5) null (unknown); and five levels of self assessments of blooding stools: (1) no, (2) a little, (3) some, (4) a lot and (5) null (unknown).

**Models**
Some major products of oils (fats) digestion are fatty acids [24]. Although the digestion of fat and the absorption of the fatty acids are performed mostly in the small intestine, there are always some remaining undigested oils (fats) or unabsorbed fatty acids in the large intestine. Usually, the more oils (fats) we take, the more oils (fats) we have in the large intestine. The normal stool contains 2–7 grams of fat per 24 hours (g/24h) [21 – 23]. We think the remaining oils (fats) can prevent the feces from over desiccation (dehydration) as well as reduce the friction of the large colon wall [24].

Fig. 1 illustrates our model of lipids and water in feces (or chyme) in the large intestine, rectum or anal canal, based on biochemistry [28] and physiology [24]. Normal feces have 75% of fluid and 25% of solid materials [36]. Therefore, to retain certain amount of fluids (major: water) in feces is a key point to ensure soft stools; and soft stools are necessary for easy molding and defecating. Hydrophilic polar heads of lipids attract water in feces and play an important role to maintain the soft stools and to prevent the constipation.
Fig. 2 illustrates our model of mass movements of feces (or chyme) in a rectum or sigmoid colon, based on biomechanics [29], anatomy [26], histology [27] and physiology [24]. The correspondent movements in other colons are similar to this model. If the mass are hard and big enough, the friction will damage the epithelium, blood vessels, nervous fibers and Lamina Propria; the mass can not be molded by anal sphincters and excreted easily; and patients feel pain. The consequence is that constipation, hemorrhoid or anal fissure occurs.

Our models of Fig. 3, 4, 5 and 6 are based on anatomy [26], physiology [24] and biomedical infophysics [30].

Fig. 3 illustrates our model of normal feces (or chymes) in the large intestine. Some water and ions (e.g., \(\text{Na}^+\) and \(\text{K}^+\)) are transported across the colon walls of the large intestine. But, some remaining oils (fats) and fatty acids are preserved in the stools and colons [21 – 23]. Because the lipid distribution is even and sufficient, the desiccation of stools is normal in this condition. There are not any desiccated and hard stools in the colons; the fecal mass can be molded by anal sphincters and excreted easily. Therefore, no constipation occurs. The next intake of edible oils (fats) should be even and unchanged in this condition.

However, the desiccation of stools may be abnormal: more or less, because of insufficient or over sufficient dose of edible oils (fats).

Fig. 4 illustrates our model of constipated feces (or chymes) in the large intestine. The lipid distribution is even, but insufficient. The leak of the intestine gases is one of other causes of severe desiccation of stools. The leak is more significant when anal fissure or dilated anal opening occurs, e.g., relaxed anal sphincters, long time of squatting or sitting. Therefore, desiccated and hard large stools occur around the anus; the fecal mass can not be molded by anal sphincters and excreted easily; and the constipation happens in this circumstance. The next intake of edible oils (fats) should be even and increased a little in this circumstance.

Fig. 5 illustrates our model of diarrheal feces (or chymes) in the large intestine. The lipid distribution is even, but over sufficient. In this situation, there are too many waters in the stools and colons. Therefore, the diarrhea occurs. The next intake of edible oils (fats) should be even and decreased a little in this situation.

Fig. 6 illustrates our model of complex feces (or chymes) in the large intestine. The lipid distribution is uneven. Stools have insufficient, sufficient and/or over-sufficient lipids respectively. In this instance, constipated (desiccated and hard, usually around anus), normal and/or diarrheal feces mix together in the colons. Therefore, constipation (usually at beginning of defecation), normal excretion, and/or diarrhea occur in succession. The next intake of edible oils (fats) should be even and sufficient in this instance.

We also propose a formula to semi quantitatively describe a relationship between the dose (\(F\)) of the edible oils (fats) in the meal (\(M\)) and the quantity (\(W\)) of water in the correspondent defecation (\(D\)) as:

\[
F = k \cdot W
\]

where \(k\) is a constant.

Initial Results

The two subjects felt no (mostly) or mild (occasionally) pain; observed no (mostly) or a little (occasionally) blood in their feces, while defecating when they followed the recipes to cook their meals.

One of the subjects did not follow the recipes to cook meals, either insufficient or uneven intake of cooking oils, respectively in October 2012 (about 4 weeks) and in September 2013 (about 3 weeks). The subject felt severe or common pain in abdomen, anus and rectum; and observed a lot or some blood in the feces while excreting stools. Some laxatives were used for the treatments, but they did not work well. The subject recovered in 3 – 4 weeks after resuming meals cooked with the recipes.

The time window is about 1 week for epithelialization and 2 – 3 weeks for dermal wound healing [37]. Our preliminary data of the healing time windows of the minor and severe pains (or a little and a lot blooding stools) caused by the constipation or anal fissures were consistent with or similar to that of skin wound healing.

Discussion

Exocrine glands of the colon walls could be damaged by the solid contents [24], e.g. hard stools. The produced wound could induce hemorrhoids or colitis, and chronic colitis could be developed to colonic cancer.

Although, in this investigation, we specially focus on modeling and providing treatment methods for constipation and diarrhea caused by incorrect dose or uneven intake of edible oils (fats) in human daily diets, we believe our models and methods are generally helpful to mechanical approaches and to medical and
veterinary managements of hemorrhoids or colitis as well as constipation and diarrhea.

We have at least two reasons to heat plant cooking oils with boiling soups rather than to directly heat them with a pot, pan or boiler to light fry foods (deep fried foods are not recommended [28, 31 – 32]).

1. Unsaturated fatty acids in plant cooking oils will be changed into saturated or trans fatty acids at high temperature [28]. Saturated or trans fatty acids are not healthful to human [31 – 32]. If we fry foods with plant cooking oils, the oil temperature can be about 200 oC [38]. If we add plant cooking oils into boiling soups, the oil temperatures are usually about 100 oC. Therefore, plant cooking oils in boiling soups are usually healthier than the frying oils.

2. The oils in boiling soups are usually evaporate less than the frying oils, because the temperature of the oils in boiling soups are much lower than that of the frying oils [38]. Therefore, in considerations of quantitative control of intake dose of cooking oil and economy, to add the oils into boiling soups is easier and better than to light fry foods with the oils.

We assume, relaxed anal sphincters, long time of sitting or squatting could make anal opening larger, the larger opening brings out more leaking gases including water; the more leaking water gases lead to more desiccated stools; fewer physical activities could result in uneven oil distribution in stools, though the total amount of edible oils (fats) are sufficient. We think, these hypotheses could be helpful to answer the question why older people have higher probability to have constipation than younger adults [3, 4, 6, 7, 10]; the hypotheses could also explain why some infants or children have constipation.

We did not perform any statistical analysis because of the number of subjects are too small (low).

Conclusion

Incorrect dose or uneven intake of edible oils (fats) in human daily diets could be factors to cause constipation or diarrhea. The constipation and diarrhea could be cured by adjusting the dose or evening the intake, of the oils (fats).

References


WebmedCentral > Research articles
Illustrations

Illustration 1

Fig 1: Our model of lipids and water in feces (or chime) in the large intestine system, rectum or anal canal. See texts. The draw is not to the scale.

Illustration 2

Fig 2: Our Model of fecal mass (feces or stools) movements in a sigmoid colon. F_p represents a strong peristaltic force. F_{p,t} and F_{p,n} represent that of the tangential and the normal respectively; F_r represents a friction. See texts. The draw is not to scale.
Blood vessels:
Nervous controlling fibers:
Nervous sensory fibers:
Feces (or chyme) (including water and lipid):
Epithelium/Intestinal Glands:
Lamina Propria:
Muscularis mucosae:

Submucosa:
Circular Membrane:
Longitudinal Membrane:
Serosa:

Moving direction of a stool mass:
Force:
Illustration 3

Fig 3: Our model of normal feces (or chyme) in the large intestine of the digestive system. See texts. The draw is not to the scale.

Illustration 4

Fig. 4: Our model of constipated feces (or chyme) in the large intestine of the digestive system. See texts. The draw is not to the scale.
Illustration 5

Fig. 5: Our model of diarrheal feces (or chyme) in the large intestine of the digestive system. See texts. The draw is not to the scale.

Illustration 6

Fig. 6: Our model of complex feces (or chyme) in the large intestine of the digestive system. See texts. The draw is not to the scale.