

World Journal of *Gastroenterology*

World J Gastroenterol 2020 November 21; 26(43): 6706-6908



OPINION REVIEW

- 6706 Gastric acid level of humans must decrease in the future
Fujimori S

EXPERT CONSENSUS

- 6710 First United Arab Emirates consensus on diagnosis and management of inflammatory bowel diseases: A 2020 Delphi consensus
Alkhatry M, Al-Rifai A, Annese V, Georgopoulos F, Jazzar AN, Khassouan AM, Koutoubi Z, Nathwani R, Taha MS, Limdi JK

MINIREVIEWS

- 6770 Hepatocellular carcinoma after direct-acting antiviral hepatitis C virus therapy: A debate near the end
Muzica CM, Stanciu C, Huiban L, Singeap AM, Sfarti C, Zenovia S, Cojocariu C, Trifan A

ORIGINAL ARTICLE**Basic Study**

- 6782 *Lactobacillus bulgaricus* inhibits colitis-associated cancer via a negative regulation of intestinal inflammation in azoxymethane/dextran sodium sulfate model
Silveira DSC, Veronez LC, Lopes-Júnior LC, Anatriello E, Brunaldi MO, Pereira-da-Silva G
- 6795 Antifungal activity and antidiarrheal activity via antimotility mechanisms of (-)-fenchone in experimental models
Pessoa MLS, Silva LMO, Araruna MEC, Serafim CAL, Alves Júnior EB, Silva AO, Pessoa MMB, Diniz Neto H, de Oliveira Lima E, Batista LM
- 6810 Effects of Yue-Bi-Tang on water metabolism in severe acute pancreatitis rats with acute lung-kidney injury
Hu J, Zhang YM, Miao YF, Zhu L, Yi XL, Chen H, Yang XJ, Wan MH, Tang WF
- 6822 Tissue microarray-chip featuring computerized immunophenotypical characterization more accurately subtypes ampullary adenocarcinoma than routine histology
Palmeri M, Funel N, Di Franco G, Furbetta N, Gianardi D, Guadagni S, Bianchini M, Pollina LE, Ricci C, Del Chiaro M, Di Candio G, Morelli L

Retrospective Cohort Study

- 6837 Feasibility and nutritional impact of laparoscopic assisted tailored subtotal gastrectomy for middle-third gastric cancer
Liu H, Jin P, Ma FH, Ma S, Xie YB, Li Y, Li WK, Kang WZ, Tian YT
- 6853 Role of doublecortin-like kinase 1 and leucine-rich repeat-containing G-protein-coupled receptor 5 in patients with stage II/III colorectal cancer: Cancer progression and prognosis
Kang XL, He LR, Chen YL, Wang SB

Clinical Trials Study

- 6867 Comparison of two supplemental oxygen methods during gastroscopy with propofol mono-sedation in patients with a normal body mass index

Shao LJZ, Zou Y, Liu FK, Wan L, Liu SH, Hong FX, Xue FS

Observational Study

- 6880 Barriers for resuming endoscopy service in the context of COVID-19 pandemic: A multicenter survey from Egypt

Elshaarawy O, Lashen SA, Makhlouf NA, Abdeltawab D, Zaghloul MS, Ahmed RM, Fathy H, Afifi S, Abdel-Gawad M, Abdelsameea E, Abd-Elsalam S, Mohamed SY, Tag-Adeen M, Tharwat M, Alzamzamy A, Bekhit AN, Eid AM, Awad A, Aamr M, Abd El Dayem WA, Wifi MN, Alborai M

SYSTEMATIC REVIEWS

- 6891 Crohn's disease in low and lower-middle income countries: A scoping review

Rajbhandari R, Blakemore S, Gupta N, Adler AJ, Noble CA, Mannan S, Nikolli K, Yih A, Joshi S, Bukhman G

ABOUT COVER

Editorial Board Member of *World Journal of Gastroenterology*, Dr. Vasiliy I Reshetnyak is a Distinguished Professor at the AI Yevdokimov Moscow State University of Medicine and Dentistry in Moscow, Russia. In 1977, he graduated with honors from the Medical Faculty of IM Sechenov 1st Moscow Medical Institute. In 1982m Dr. Reshetnyak defended his PhD thesis. Working at the Central Research Institute of Gastroenterology (CRIG) led to obtainment of his doctoral thesis (DSc) in 1996 and his rise to Deputy Director on Scientific Work at the CRIG. Since 2003, Professor Reshetnyak has served as an Academic Secretary of the Research Institute of General Reanimatology. His scientific research activity has focused on the diagnosis, clinical and laboratory manifestations, and treatment of gastroenterological diseases with patients in critical states. Since 2019, Dr. Reshetnyak has held the rank of Professor of the Department of Propaedeutic of Internal Diseases and Gastroenterology. (L-Editor: Filipodia)

AIMS AND SCOPE

The primary aim of *World Journal of Gastroenterology (WJG, World J Gastroenterol)* is to provide scholars and readers from various fields of gastroenterology and hepatology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online. *WJG* mainly publishes articles reporting research results and findings obtained in the field of gastroenterology and hepatology and covering a wide range of topics including gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, gastrointestinal oncology, and pediatric gastroenterology.

INDEXING/ABSTRACTING

The *WJG* is now indexed in Current Contents®/Clinical Medicine, Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports®, Index Medicus, MEDLINE, PubMed, PubMed Central, and Scopus. The 2020 edition of Journal Citation Report® cites the 2019 impact factor (IF) for *WJG* as 3.665; IF without journal self cites: 3.534; 5-year IF: 4.048; Ranking: 35 among 88 journals in gastroenterology and hepatology; and Quartile category: Q2.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Yu-Jie Ma*; Production Department Director: *Xiang Li*; Editorial Office Director: *Ze-Mao Gong*.

NAME OF JOURNAL

World Journal of Gastroenterology

ISSN

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

LAUNCH DATE

October 1, 1995

FREQUENCY

Weekly

EDITORS-IN-CHIEF

Andrzej S Tarnawski, Subrata Ghosh

EDITORIAL BOARD MEMBERS

<http://www.wjgnet.com/1007-9327/editorialboard.htm>

PUBLICATION DATE

November 21, 2020

COPYRIGHT

© 2020 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/GerInfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>

Gastric acid level of humans must decrease in the future

Shunji Fujimori

ORCID number: Shunji Fujimori
0000-0002-6214-2595.

Author contributions: Fujimori S contributed to the writing this paper.

Conflict-of-interest statement: The author declares no conflict of interest.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Manuscript source: Unsolicited manuscript

Specialty type: Gastroenterology and hepatology

Country/Territory of origin: Japan

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B, B
Grade C (Good): C, C

Shunji Fujimori, Department of Gastroenterology, Chiba Hokusoh Hospital, Nippon Medical School, Inzai 270-1694, Chiba, Japan

Corresponding author: Shunji Fujimori, MD, PhD, AGAF. Director, Department of Gastroenterology, Chiba Hokusoh Hospital, Nippon Medical School, 1715 Kamagari, Inzai 270-1694, Chiba, Japan. s-fujimori@nms.ac.jp

Abstract

Proton pump inhibitors strongly inhibit gastric acid production, but digestion problems do not generally arise. We can intake almost ordinary food even after total gastrectomy. Small intestine itself can digest and absorb food using various digestive enzymes without digestion in the stomach. The pH level of gastric acid in humans is much lower than that of most animals, and very close to that of carrion-eating animals called scavengers. It is assumed that ancient humans became bipedal approximately 4 million years ago. It was difficult for humans, who just started unstable bipedal locomotion, to catch quadrupedal-walking animals that can move faster, without special hunting tools. They may have eaten remaining carcasses, which is mainly the leftovers of carnivora species, as animal-derived food. The benefit to produce a volume of gastric acid for humans is carrion eating, in which disinfection by gastric acid is important. Humans produce a high concentration of gastric acid to enable consumption of a diet containing some bacteria and support this lifestyle by consuming significant energy to protect themselves from gastric acid. Now, the opportunity for strong deleterious bacteria to enter the gastrointestinal tract has decreased because of the organized clean environment. If this hygienic environment is maintained for a long time, our gastric acid level must be decreased gradually.

Key Words: Gastric acid; Proton pump inhibitor; Digestion; Scavenger; Carrion eating; Ancient humans

©The Author(s) 2020. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: We can intake almost ordinary food even after total gastrectomy. Small intestine itself can digest and absorb food without digestion in the stomach. The pH level of gastric acid in humans is much lower than that of most animals, and very close to that of carrion-eating animals. The benefit to produce a volume of gastric acid for humans is carrion eating, in which disinfection by gastric acid is important. Now, we

Grade D (Fair): 0

Grade E (Poor): 0

Received: August 2, 2020**Peer-review started:** August 2, 2020**First decision:** October 18, 2020**Revised:** October 24, 2020**Accepted:** November 2, 2020**Article in press:** November 2, 2020**Published online:** November 21, 2020**P-Reviewer:** Chen YD, Shi H, Tang ST, Yang L**S-Editor:** Zhang L**L-Editor:** A**P-Editor:** Wang LL

have decreased risk of food poisoning because of clean environment. If this hygienic environment is maintained for a long time, our gastric acid level must be decreased gradually.

Citation: Fujimori S. Gastric acid level of humans must decrease in the future. *World J Gastroenterol* 2020; 26(43): 6706-6709

URL: <https://www.wjgnet.com/1007-9327/full/v26/i43/6706.htm>

DOI: <https://dx.doi.org/10.3748/wjg.v26.i43.6706>

INTRODUCTION

In recent years, the number of patients with reflux esophagitis has increased due to life-span extension and food satiation, and proton pump inhibitors (PPIs), strong acid reducers, are increasingly prescribed. People are concerned about side effects of PPIs associated with the increase in the number of prescription^[1]. However, it is generally understood that PPIs are relatively safe; PPIs strongly inhibit gastric acid production, but digestion problems do not generally arise, with some impaired absorption of vitamin B12. We discuss gastric acid in humans by focusing on why strong inhibition of gastric acid does not significantly affect digestion.

GASTRIC ACID IN HUMANS

Digestion by gastric acid and pepsin is potent and can completely decompose animal-derived food. However, the decomposition takes time. For example, a snake swallows a whole animal and digests it at a gastric acid level (pH 1.5-2.0), the same as that in humans, but it takes approximately one week for the digestion process, depending on the size of the swallowed animal^[2,3]. Modern humans maintain food in the stomach for approximately four hours, and there is a limitation to the digestive ability of the stomach^[4]. The less cooked food that might have been served by ancient people would need more than four hours to digest in the stomach. Of course, the digestion time in the stomach in the ancient period might have been longer than that in present time, but strong digestive ability of the small intestine in modern humans is not necessary if digestion in the stomach is adequate.

We can intake almost ordinary food even after total gastrectomy, although we need to take food in small increments since the stomach cannot hold food. We are able to do so because the small intestine can digest and absorb food using various digestive enzymes without digestion in the stomach. Although impaired absorption of vitamins and minerals occurs due to the evolved absorption system of humans, the small intestine can still digest food. We captured how solid food is digested in the small intestine using capsule endoscopy and found that not only carbohydrates and meat but also the cytoplasm of plants are absorbed in the small intestine^[5]. In other words, we endoscopically confirmed that the passage of current formed food through the stomach does not influence digestion in the small intestine. Because a patient who takes PPIs does not have any major digestive/absorption problems, the importance of gastric acid in the digestive system of humans is thought to be low. Nevertheless, the gastric acid level of humans is considerably high compared to that of many other animals^[6].

The pH of gastric acid in humans is 1.5-2.0. According to a report summarized by Beasley *et al*^[6], the pH level is much lower than that of most animals, including anthropoids (≥ 3.0), and very close to that of carrion-eating animals called scavengers, such as falconine birds and vultures^[6]. This report shows a trend that pH in the stomach is the highest in herbivores and decreases in order of carnivores, omnivores, and scavengers (Figure 1). The pH of humans is lower among omnivores and equal to scavengers. Herbivores eat raw plants that are protected by sunlight and antibacterial agents produced from the plant, therefore have less-toxic bacteria. Also, normal carnivores eat non-festering meat that is freshly killed. Carrion that is left over of such carnivores has no small highly virulent bacteria and carrion-eating needs a system to disinfect the bacteria. It has been thought that one of the disinfection system is the strong acid in the stomach. Living organisms use great energy to produce gastric acid.

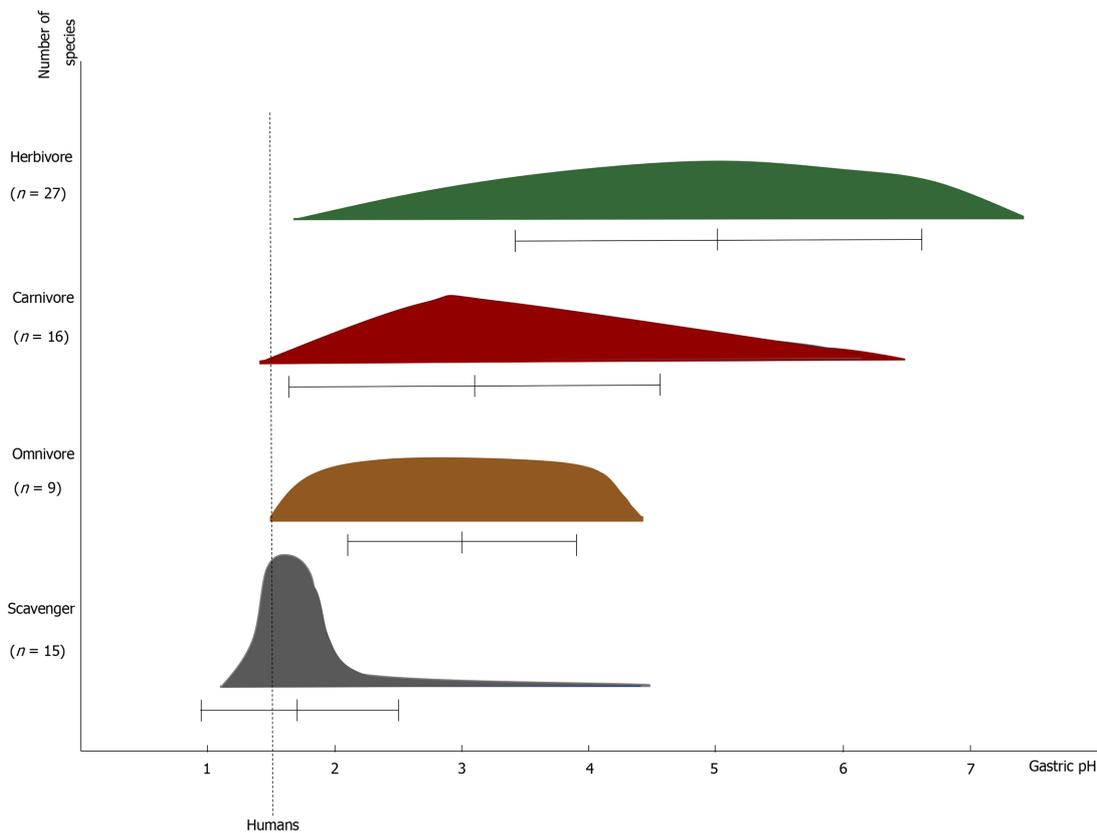


Figure 1 pH of mammals and avian species according to feeding habit. Forty-two mammals and 25 avian species except human summarized by Beasley *et al*^[6] were categorized in herbivore, carnivore, omnivore, and scavenger and the distribution of species against pH in the stomach was expressed in a scheme. The scheme was deformed due to its large variance. mean \pm SD of the pH is inserted below.

First, they need energy to produce gastric acid itself^[7]. In addition, they need to protect the gastric mucosa from gastric acid, protect against back-flow of gastric fluid in the esophagogastric junction, and neutralize gastric acid immediately in the duodenum for protection^[8,9]. The benefit of the effort to produce gastric acid for humans is carrion eating, in which disinfection by gastric acid is important.

It is assumed that ancient humans became bipedal approximately 4 million years ago^[10]. It was difficult for humans, who just started unstable bipedal locomotion without special hunting tools, to catch quadrupedal walking animals that can move faster. They may have eaten remaining carcasses, which is mainly the leftovers of carnivora species (bone marrow), as animal-derived food^[11]. This hypothesis has been proven from bone-destroying stone artifacts. In other words, humans may have survived and developed as a carrion-eating animal. To enable this method of subsistence, humans needed enhanced bactericidal power, and individuals adopted increased gastric acid levels, which is preserved in modern humans. This high gastric acid level enables relatively long-term use of animal-derived food, which is difficult to preserve, and may support a wide variety of dietary habits of humans as omnivores.

CONCLUSION

As stated above, humans have adjusted to the environment as omnivorous mammals that can consume carrion. Humans produce a high concentration of gastric acid to enable consumption of a diet containing some bacteria and support this lifestyle by spending significant energy to protect themselves from gastric acid. We have decreased the opportunity for strong deleterious bacteria to enter the gastrointestinal tract because of the organized clean environment, especially in developed countries. If this hygienic environment is maintained for a long time, our gastric acid level must be decreased gradually, with some modification in the absorption system.

REFERENCES

- 1 **Nehra AK**, Alexander JA, Loftus CG, Nehra V. Proton Pump Inhibitors: Review of Emerging Concerns. *Mayo Clin Proc* 2018; **93**: 240-246 [PMID: 29406201 DOI: 10.1016/j.mayocp.2017.10.022]
- 2 **Yonezawa H**, Nonaka T, Uchikoba T, Hattori S, Ohno M, Kaneda M. Isolation and characterization of pepsinogen from *Trimeresurus flavoviridis* (Habu snake). *J Biochem* 2000; **127**: 755-760 [PMID: 10788783 DOI: 10.1093/oxfordjournals.jbchem.a022667]
- 3 **Secor SM**. Gastric function and its contribution to the postprandial metabolic response of the Burmese python *Python molurus*. *J Exp Biol* 2003; **206**: 1621-1630 [PMID: 12682094 DOI: 10.1242/jeb.00300]
- 4 **Pathikonda M**, Sachdeva P, Malhotra N, Fisher RS, Maurer AH, Parkman HP. Gastric emptying scintigraphy: is four hours necessary? *J Clin Gastroenterol* 2012; **46**: 209-215 [PMID: 21959322 DOI: 10.1097/MCG.0b013e31822f3ad2]
- 5 **Fujimori S**. Capsule endoscopy for investigating the digestion process. *VideoGIE* 2020; **5**: 14-15 [PMID: 31922073 DOI: 10.1016/j.vgie.2019.10.009]
- 6 **Beasley DE**, Koltz AM, Lambert JE, Fierer N, Dunn RR. The Evolution of Stomach Acidity and Its Relevance to the Human Microbiome. *PLoS One* 2015; **10**: e0134116 [PMID: 26222383 DOI: 10.1371/journal.pone.0134116]
- 7 **Scott DR**, Helander HF, Hersey SJ, Sachs G. The site of acid secretion in the mammalian parietal cell. *Biochim Biophys Acta* 1993; **1146**: 73-80 [PMID: 8382956 DOI: 10.1016/0005-2736(93)90340-6]
- 8 **Szabo S**. Mechanisms of gastric mucosal injury and protection. *J Clin Gastroenterol* 1991; **13** Suppl 2: S21-S34 [PMID: 1885900 DOI: 10.1097/00004836-199112002-00005]
- 9 **Allen A**, Flemström G. Gastroduodenal mucus bicarbonate barrier: protection against acid and pepsin. *Am J Physiol Cell Physiol* 2005; **288**: C1-19 [PMID: 15591243 DOI: 10.1152/ajpcell.00102.2004]
- 10 **Richmond BG**, Strait DS. Evidence that humans evolved from a knuckle-walking ancestor. *Nature* 2000; **404**: 382-385 [PMID: 10746723 DOI: 10.1038/35006045]
- 11 **Mann NJ**. A brief history of meat in the human diet and current health implications. *Meat Sci* 2018; **144**: 169-179 [PMID: 29945745 DOI: 10.1016/j.meatsci.2018.06.008]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: <https://www.f6publishing.com/helpdesk>
<https://www.wjgnet.com>

