# Hydrogen Gas Production in Turkish Population

Dr. A. ÖZDEN, Ö. KOÇ, B. YEŞİLDAĞ, Dr. M.K. BALCI, Dr. E. BAŞPINAR

***Özet:*** *TÜRK TOPLUMUNDA HİDROJEN GAZI ÜRETİMİ*

*Laktaz yetmezliği prevalansı yaklaşık %80 olan Türk toplumanda hidrojen gazı üretimi $H_2$ nefes teti yöntemiyle belirlendi. Bu test ortalama yaşı 26.7 yıl (%13-65 yaşları arasında) olan 161 sağlıklı kişiye uygulandı. 161 deneğin 75'i erkek, 86"sı kadındı ve çalışma öncesi bir ay süresince herhangi bir antibiyotik almamışlardı. Hidrojen nefes testi bir gece açlık sonrası 250 ml musluk suyunda eritilmiş 20 gr. laktulozun oral alınması sonrası uygulandı. Bu disakkardiin alınmasından önce ve sonra, ekspirasyon sonu hava, 3 saat süresince 30 dakikada bir, düşük hidrojen gazı üretimi olanlar için ise 4 saat süreyle toplandı. Nefes hidrojen gazı konsantrasyonunda 20 gr. laktuloz alımı sonrası açlık düzeyine göre 20 ppm'den daha az artış olduğunda düşük hidrojen üretimi düşünüldü. Yüzaltmışbir deneğin, 149'unda normal hidrojen üretimi (%92.5), 12'sinde ise düşük üretim (%7.5) bulundu. Normal hidrojen üretimi olan 10(%83) denekte şu yakınmalar gözlendi; karında distansiyon, ağrı ve diare. Bu bulgular emilmeyen karbohidratların metabolizmasının kolonik bakteriler tarafından farklı kişilerde değişik olabileceğini göstermektedir.*

**Anahtar Kelimeler:** Nefes hidrojen testi, laktuloz, Türk toplumu

***Summary:*** *$H_2$ production in Turkish population who has lactase deficiency prevalence of about 80%, was studied with the lactulose $H_2$ breath tests. These tests were applied to 161 healthy persons. The average age of these persons was 26.7 years (between the ages of 13 and 65 years). Of the 161 cases, 75 were male and 86 were female. They had not taken any antibiotics during the last month prior to the study. The hydrogen breath tests were performed by ingestion of 20 g lactulose diluted with 250 ml tap water after an overnight fast. Before and after the ingestion of this disaccharide, the end expiratory air was collected in 30 minutes intervals for 3 hours, in low $H_2$ producers for 4 hours. An increase less than 20 ppm in breath $H_2$ concentration over fasting level after the ingestion of 20 g lactulose was considered as low hydrogen production. Of the 161 persons, 149 were found to be normal $H_2$ producers (92.5%), and 12 as low producers (7.5%). In 109 cases of normal $H_2$ producers (73%), and 10 cases of low $H_2$ producers (83%), two of the following complaints were observed during the tests; abdominal distention, pain and diarrhea. These findings indicate that the metabolism of nonabsorbed carbohydrates by colonic bacteria may be different in some cases.*

**Key Words:** Breath hydrogen tests, lactulose, Turkish population

Hydrogen gas is not formed by human cellular metabolism is usually produced in the human colon by the fermentation of unabsorbed carbohydrate with colonic bacteria. About 20% of hydrogen diffuses through the colon into the blood, then through the liver, it reaches the lung and is excreted in the breath. Hydrogen production is negligible in the small intestine of normal subjects(1). Production of hydrogen depends on the presence of the able colonic flora to produce hydrogen by fermenting malabsorbed carbohydrate(2).

Gastroenterology Department of The Medical School of Ankara University.

The measurement of hydrogen in the end expiratory air by interval sampling, has been used to determine carbohydrate malabsorption, small bowel bacterial overgrowth and orocaecal transit time. It is a non-invasive and simple test. If the colonic bacterial flora is unable to produce $H_2$ by metabolizing malabsorbed carbohydrates to hydrogen. This test cannot be used to determine carbohydrate malabsorption and orâcaecal transit time(3).

The colonic bacterial flora necessary for production of hydrogen may vary after laxatives, bowel cleansing and many antibiotics. Breath

hydrogen excretion is affected also by smoking, diet, ventilatory rate, exercise, emotional stress, intestinal motility(4). Some of normal subjects fail to show an increase of more than 20 ppm over fasting level in breath hydrogen excretion after the ingestion of lactulose. The prevalence of low hydrogen producers in normal population varies from 0 to 21%(5,6). The differences in hydrogen production reported by various researchers may be due to different dietary habits and ethical differences influencing the colonic flora(7).

In our previous study, low hydrogen producers was observed in 14.6% of lactase normal subjects and 5% of lactase deficient subjects. The subjects were between the ages of 3-60 years old. There was no low hydrogen producers in the group of 3 to 6 years.

In this study, the prevalence of low hydrogen producers was studied in Türkiye where lactase deficiency was previously found to be about 80% by us(8).

## MATERIALS and METHODS

161 healthy subjects were studied from a nurse training collega, a university, a medical school and relatives of patients. 86 of the subjects were females and 75males, aged between 13-65 years, with a mean of 26±1.01 years.

All the subjects were healthy when studied, had not taken any antibiotics recently, and had had no gastrointestinal diseases. The diet of the day prior to test was not controlled. Eating, drinking, and smoking were prohibited the morning of the test. All patients sat during the test in the clinic's library.

After an overnight fast, a lactulose load of 20g/250 ml $H_2O$ was administered to each subject. Breath samples were obtained before ingestion of lactulose and every 30 min. for 3 hrs. The subjects who were observed to be low hydrogen producers after 3 hrs, were observed for an additional hour. A commercially available dual bag system was used for collection of the end expiratory air (Quintron Products). Hydrogen concentration in the samples was measured immediately by using hydrogen chromatograph (Quintron Clinical Microlyzer). This instrument was standardized with a gas of known $H_2$ concentration (100 ppm). An increase less than 20 ppm in breath hydrogen concentration over fasting level considered as low hydrogen production. Subjects were asked to report the occurence of abdominal distention, colicky pain and diarrhea during three or four hours after 20 g lactulose administration.

One week after the lactulose test, low hydrogen producers in the 161 subjects were subjected to lactose-hydrogen breath test and lactose tolerance test. After an overnight fast a lactose load of 50 g/500 ml $H_2O$ was given to the low hydrogen producers who were all above 50 kg of weight. Breath samples were obtained before ingestion of lactose and every 30 min. for 3 hrs, blood samples for 2 hrs. Hydrogen concentration was measured as described above. Blood sugar determinations were carried out using the method Folin Wu. An increase in breath hydrogen of more than 20 ppm over fasting level of breath hydrogen was accepted as the evidence of lactose malabsorption and normal hydrogen producers with 50 g lactose. An increase in the blood sugar level more than 20 mg over basal level of blood sugar considered as the evidence of normal lactose absorption.

## RESULTS

After 161 subjects were loaded with 20 g lactulose, 149 were found to be normal hydrogen producers (92.5%) and 12 as low producers (7.5%). The results are presented in Table 1 and Table 2. In 109 subjects of normal hydrogen producers (73%), and 10 subjects of low hydrogen producers (83%), two of the following complaints were observed during the test, abdominal distention, colicky pain and diarrhea.

12 low hydrogen producers who were previously subjected to lactulose test, were loaded 50 g lactose. 8 of these 12 subjects became normal hydrogen producers. In the remaining 4 subjects hydrogen concentration was still low. In two of these four subjects were found to be lactose malabsorber and the other 2 lactose absorber by blood sugar measurements.

## DISCUSSION

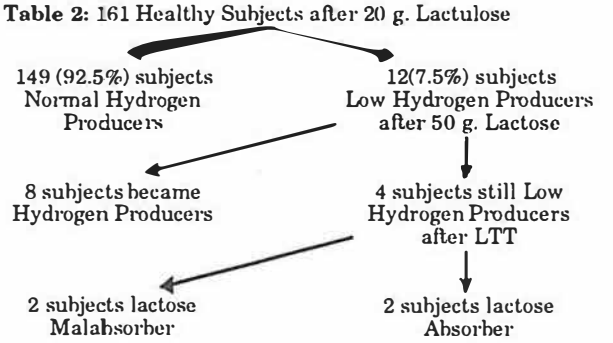
The reason for low hydrogen production in the

**Table 1:** Mean $H_2$ Production by two Groups after Ingestion of 20 Grams of Lactulose

| Time (min) | Producers* | Low Producers* |
|---|---|---|
| 0 | 04.91±0.36 | 3.75±1.00 |
| 30 | 11.58±1.90 | 4.08±0.93 |
| 60 | 26.89±2.40 | 5.25±1.01 |
| 90 | 47.36±3.30 | 8.83±1.85 |
| 120 | 59.66±3.27 | 8.50±1.99 |
| 150 | 62.12±3.10 | 7.00±1.64 |
| 180 | 50.97±2.81 | 6.25±1.70 |
| 210 | - | 5.42±0.85 |
| 240 | - | 4.75±0.69 |

*$H_2$ (ppm±SEM)

**Table 2:** 161 Healthy Subjects after 20 g. Lactulose




LTT: Lactose Tolerance Test

colon is not clear. It is quite possible several factor maybe responsible for this phenomenon, such as intestinal motility, colonic flora, local colonic pH and amount of carbohydrate giving for the test(9). Although the different results may be due to geographical differences and dietary habits. They can be attributed to different criteria used to define low producers by various authors(10).

In our study, an acceptable strict criteria was used. In determining the prevalence of low hydrogen producer, it is appropriate to report type and quantity of carbohydrate used for the test. In this study, the prevalence of low hydrogen producers with 20 g lactulose was found to be 7.5% (in 12 of 161 subjects). In 8 of these 12 (66.6 %) normal hydrogen production was observed after loading with 50g lactose. This finding in these 8 subjects leads us to think that bacterial metabolism of lactulose, lactose in the colon may be different in some cases.

Two of 4 subjects was lactose malabsorber and the other two lactose absorber according to lactose tolerance test. One would expect normal hydrogen production in 2 lactose malabsorber subjects but these 2 subjects were found to be low hydrogen producers after lactulose and lactose loading. As this finding in these 2 subjects indicate, in some people bacterial flora may not produce enough hydrogen when loaded with lactulose or lactose, or may consume the produced hydrogen(11).

**KAYNAKLAR**

1. Levitt Md, Donaldson RM. Use of respiratory hydrogen ($H_2$) excretion to detect carbohydrate malabsorption. J. Lab Clin Med 75: 937-945, 1970.
2. Bartlett K, Dobson JV, Eastham E. A new method for the detection of hydrogen in breath and its application to acquired and inborn sugar malabsorption. Clin Chim Acta 108: 189-94, 1980.
3. La Brooy SJ, Male PS, Beans AK, Misiewicz JJ. Assessment of the reproducibility of lactulose $H_2$ breath test as a measure of mouth to caecum transit time. Gut 24: 893-896, 1983.
4. Gilat T, Hur HB, Gelman-Malachi E, Terdiman R. Alteration of the colonic flora and their effect on the hydrogen test. Gut 19: 602-605, 1978.
5. Levitt MD. Production and excretion of hydrogen gas in man N. Eng. J. Med. 281: 122-127, 1969.
6. Saltzberg DM, Levine GM, Lubar C. Impact of age, sex, race and functional complaints on hydrogen (H2) production. Dig Dis Sci 33: 308-3138, 1988.
7. Patel VP, Jain NK, Pitchumon CS. Factors affecting fasting breath hydrogen levels in healthy adults. A study in two continents. Am J Gastroenterol 81: 771-73, 1986.
8. Özden A, Soylu K, Ekinci C, Uzunalimoğlu Ö, Sipahi N, Paykoç Z. Prevalence of primary lactase deficiency in Turkish adults. Am J Gastroenterol 80: 847, 1985.
9. Perman JA, Modler S, Olson AC. Role of pH in production of hydrogen from carbohydrates by colonic bacterial flora. J Clin Invest 67: 643-650, 1981.
10. Vogelsang H, Ferenci P, Frotz S, Meryn S, Gangl A. Acidic colonic microclimate-possible reason for false negative hydrogen breath tests. Gut 29: 21-26, 1988.
11. Florent C, Flourie B, Lebland A, Rautureau M, Bernier J-J. Influence of chronic lactulose ingestion on the colonic metabolism of lactulose in man. J Clin Invest 75: 608-613, 1984.