E: info@rmalab.com
P: 403-241-4500
F: 403-241-4501
www.rmalab.com

Rocky Mountain Analytical®
Changing lives, one test at a time

Date of Collection: 2018/02/04
Time of Collection: 12:00AM
Date of Receipt: 2018/02/09
Reported On: 2018/03/14

Gut-Well ™ — Accession: 123456

Healthcare Professional

Feel Your Best Clinic
Dr. Gathelthi
105 32 Dream Drive NW
Calgary, AB T3P 0R9

P: 403-555-4500
F: 403-555-4501

Patient

Jane Doe
1234 Health Street
Calgary, AB A1M
2X3 P:403-555-1234

Age: 41
Date of Birth: 1976/06/02
Gender: Female

gut-well

Stool Appearance

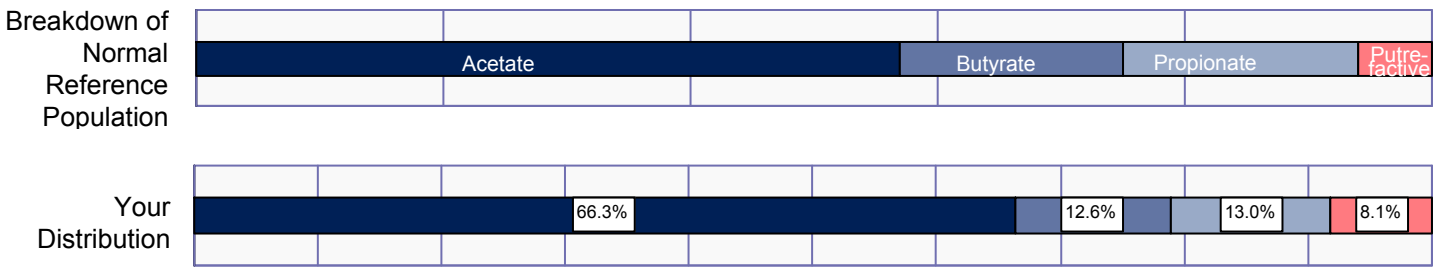
Colour	Brown
Consistency	Formed

Short Chain Fatty Acid (SCFA) Profile

Analyte	Result	Range	0% 20% 40% 60% 80% 100%	Rank
Total SCFA (umol/gm)	50	70 - 180		7.7%
Total Beneficial SCFA (umol/gm) *Fiber/Carbohydrate-derived*	46	63 - 180		7.7%
Total Putrefactive SCFA (umol/gm) *Protein-derived SCFA*	4.0	3.8 - 9.7		18%
n-Butyrate (umol/gm)	6.3	9.4 - 43		12%

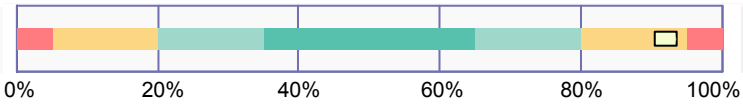
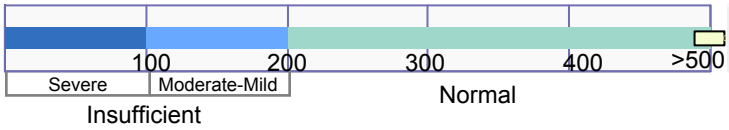
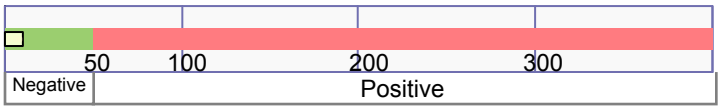
SCFA Distribution (percentages of Total SCFA)

Normal Distribution:
- Acetate (52 - 62%)
- Propionate (15 - 22%)
- Butyrate (12 - 24%)
- Putrefactive (3 - 8%)



Co-Signing Physician:
Clare Westmacott, MD
Calgary, AB
Phone (403) 278-1405

Other Stool Chemistry

Fecal Analytes	Result	Range		Rank
Fecal Fat (% of specimen weight)	7.5	2.8 - 6.4		92%
Elastase (ug/gm)	610	>200		n/a
Calprotectin (ug/gm)	< 5.0	<100		n/a

	Within	Outside	Reference Range	
Secretory IgA (ug/gm)		890	930 - 6,500	15.1

Microbiology

Stool Culture

COLLECTED 04-FEB-2018
- 10 day cold enrichment for Yersinia is performed on all stool specimens. Further report will follow if positive.

Report Status: Final

Organism 1: NO GROWTH OF SALMONELLA, SHIGELLA, PLESIOMONAS, CAMPYLOBACTER, YERSINIA, AEROMONAS, VIBRIO, E.COLI O157:H7 OR OTHER SHIGATOXIN PRODUCIN(E.COLI AT 48 HOURS

Clostridium difficile Toxin Assay

COLLECTED 04-FEB-2018
- Clostridium difficile testing is not performed on formed stools.

Result Status: Final

Parasitology

Ova and Parasite Examination

COLLECTED 04-FEB-2018

Report Status: Final

Result: NO OVA OR PARASITES SEEN

George Gillson MD, PhD
Medical Director

Note: The College of Physicians and Surgeons of Alberta - To be determined

SHORT-CHAIN FATTY ACIDS OVERVIEW

Historically, humans ate large amounts of plants: fruits, vegetables, seeds, nuts. These all contain a vast array of complex molecules loosely referred to as fibre. Researchers have studied and categorized this plant-derived material endlessly: insoluble fibre, soluble fibre, non-starch fibre, simple sugars, starch, resistant starch, pectin and so on. In this report, for simplicity we will refer to the entire collection as "fibre/carbohydrate."

The short-chain fatty acids measured in this test consist of straight-chain and branched-chain varieties. The straight-chain fatty acids come from the catabolism or "fermentation" of fibre/carbohydrate substrates and they are commonly referred to as "Beneficial" fatty acids. (Valerate is a straight chain fatty acid that can arise from both plant and animal sources, but most commonly it is included in the tally of Putrefactive fatty acids. It normally comprises approximately 2% of the total fatty acids in stool.) The branched-chain fatty acids arise primarily from the catabolism of animal proteins from flesh and eggs. The branched-chain fatty acids are referred to as "Putrefactive" fatty acids.

Both classes of fatty acids are critical to survival, growth and repair, despite the somewhat archaic class names.

Wong, J., et al. Colonic Health: fermentation and short chain fatty acids. J Clin. Gastroenterol. 2006. 40(3):235-243
Tan, J., et al. The role of short-chain fatty acids in health and disease. Advances in Immunology. Chapter 3. 2014. Vol 121: 91-119.
Rios-Covian, D., et al. Intestinal Short Chain Fatty Acids and their link with Diet and Human Health. Frontiers in Microbiology. 2016. 7(185):1-9.

UNITS FOR SCFA

When testing analytes in stool, it is common practice in the industry to report results per specimen weight e.g. units/gm or umol/gm. Some kit manufacturers also choose to use the approximation that 1 gm of stool has a density of 1 mL, thereby allowing for reporting as units/mL or umol/mL by some other laboratories.

TOTAL SCFA IN BOTTOM TERTILE

The principal short-chain fatty acids consist of the beneficial (fibre/carbohydrate-derived) fatty acids acetate, propionate and butyrate, and the putrefactive (protein-derived) fatty acids valerate, iso-valerate and iso-butyrate. Valerate is a special case. (See overview.)

In general, a normal level of total short-chain fatty acids reflect overall health of the colonic bacterial popuation. This in turn reflects intake of fibre/carbohydrate-containing foods and also reflects the nature of the bacterial community (species diversity, presence/absence of keystone organisms).

This patient's result for total short-chain fatty acids is in the lower third of the reference distribution. Low total SCFAs may be seen in inflammatory bowel disease, irritable bowel syndrome, colorectal cancer, low fibre/carbohydrate-containing food intake and antibiotic use (especially IV, multiple antibiotics sequentially or concurrrently, chronic antibiotic use/multiple courses per year).

Low total SCFA results can also be seen in calorie-restricted diets, starvation and fasting as well as long intestinal transit time. Long transit time allows for more absorption of short-chain fatty acids into the systemic circulation in the proximal intestine, leaving fewer fatty acids arriving at the distal colon.

TOTAL BENEFICIAL (FIBRE/CARBOHYDRATE-DERIVED) SCFA IN BOTTOM TERTILE

The beneficial fatty acids consist of acetate, propionate and n-butyrate. Of the three main fatty acids listed above, acetate typically makes up approximately half of the total. Valerate is also considered by some to be a beneficial short-chain fatty acid although it correlates more strongly to the putrefactive fatty acids in our reference population.

This patient's result for total fibre/carbohydrate-derived short-chain fatty acids is in the lower third (bottom tertile) of the reference distribution, The comments for this finding are basically the same as those for total short-chain fatty acids, since the beneficial fatty acids typically comprise 90-95% of all short-chain fatty acids. As discussed above, beneficial fatty acids arise from consumption of fibre/carbohydrate-containing foods.

Wong, J., et al. Colonic Health: fermentation and short chain fatty acids. J Clin. Gastroenterol. 2006. 40(3):235-243
Shi, Y., et al. Function and clinical implications of short-chain fatty acids in patients with mixed refractory constipation. Colorectal Disease. 2016. 18:803-810.

TOTAL PUTREFACTIVE (PROTEIN-DERIVED) SCFA IN LOWEST TERTILE
The principal putrefactive (protein-derived) short-chain fatty acids are valeric, isovaleric and isobutyric acid. In aggregate they comprise about 5% of the total short-chain fatty acids.

For this patient, total putrefactive fatty acids are in the lowest third (bottom tertile) of the reference distribution.

In adults, this is generally taken to reflect low protein intake which could be seen in frequent fasting. Individuals following Vegetarian or Vegan diets may exhibit low putrefactive short-chain fatty acids.

The number of young children (< 3 years old) in our reference population was small compared to the adult population. The finding of low putrefactive fatty acids should be interpreted in light of the clinical situation (dietary history, overall health) in children under the age of three years.

n-BUTYRATE IN BOTTOM TERTILE
n-Butyrate is a 4-carbon fatty acid produced in the large intestine by numerous species of bacteria as a metabolic end-product of dietary fiber and carbohydrate fermentation. Once synthesized and secreted by the microflora, butyrate is rapidly absorbed by colonocytes where it serves numerous functions related to colonic cell metabolism and homeostasis. As the major energy substrate for colonic epithelial cells, butyrate supports cellular proliferation, survival and maintenance of a normal colonocyte phenotype. In a paradoxical fashion, butyrate has anti-carcinogenic properties in the colon, by acting as a HDAC inhibitor and promoting apoptosis in cancerous cells. Butyrate acts as a potent anti-inflammatory agent in the colon by inhibiting the master pro-inflammatory NF-kB pathway, and can increase intestinal barrier integrity by up-regulating the expression of mucin glycoproteins. As a result of the numerous beneficial functions of butyrate, it has come to be considered a biomarker of overall colonic health. Since it is rapidly absorbed and metabolized by colonocytes, concentrations of butyrate are negligible in the blood and so fecal samples are used to assess production.

The n-butyrate result for this patient lies in the bottom third (bottom tertile) of the reference distribution. Low butyrate is associated with colorectal cancer, inflammatory bowel disease, irritable bowel syndrome. The most probable cause of low n-butyrate is insufficient intake of foods high in resistant starches, such as: lentils, chickpeas, buckwheat, kidney beans, millet, brown rice, garlic, asparagus, leeks, onions, green bananas, Jerusalem artichoke.

Long transit times may lead to low fecal butyrate as more time is afforded for butyrate to be absorbed into the systemic circulation before it can reach the distal colon. Absence of butyrogenic flora due to antibiotic use and disrupted ecology due to pathogen overgrowth should also be considered when n-butyrate is low.

Tan, J., et al. The Role of Short Chain Fatty Acids in Health and Disease. Advances in Immunology. 2014. 121:91-119.
Pryde, S., et al. The microbiology of butyrate formation in the human colon. FEMS Microbiology Letters. 2002. 217:133-139.
Rios-Covian, D., et al. Intestinal Short Chain Fatty Acids and their link with Diet and Human Health. Frontiers in Microbiology. 2016. 7(185):1-9.
Sivaprakasam, S., et al. Benefits of short-chain fatty acids and their receptors in inflammation and carcinogenesis. Pharmacology & Therapeutics. 2016. 164:144-151.
Zateski, A., et al. Butyric acid in irritable bowel syndrome. Prz Gastroenterology. 2013. 8(6):350-353.

FECAL FAT PERCENTAGE IN UPPER TERTILE
Note that the reference range used here for fecal fat was derived using specimens solicited by Rocky Mountain Analytical using a set of criteria developed by Rocky Mountain Analytical. They were point samples as opposed to 72-hour collections. Donors were not given any dietary guidelines to follow in the day immediately preceding collection. The distribution of the results we obtained is approximately lognormal and was modeled using a Generalized Logistic model.

The percentage of solvent-extractable fats is in the upper tertile of the reference distribution for this patient. This may simply reflect that the patient is eating a diet with a higher-than-average fat content. Other explanations might include pancreatic enzyme insufficiency and problems absorbing fat in the proximal small intestine.

Correlation analysis of the findings for our reference population did not reveal any correlation between fecal fat and total short-chain fecal fatty acids, nor between fecal fat and total putrefactive fatty acids.

ELASTASE ABOVE 500 ug/mL
Elastase below 200 ug/mL is considered low. Although this patient's result for elastase lies above 500 ug/mL, results in this range are not an abnormal finding in the population tested to establish our reference ranges.

CALPROTECTIN NEGATIVE
Calprotectin is derived from neutrophils drawn to the site of active inflammation in the colonic mucosa. Elevated calprotectin is correlated to the presence and severity of inflammatory bowel disease and is also elevated in the setting of diverticulitis, malignancy and infection. Normal or negative calprotectin helps to distinguish between inflammatory bowel disease and irritable bowel syndrome.

The cutoff for normal or negative Calprotectin is 50 ug/mL. This patient's result is negative or normal.

SECRETORY IgA IS LOW
Secretory IgA (sIgA) is the principle antibody present in colonic epithelial secretions. It plays a central role in continuous fine-tuning of the balance between normal flora, and in detection of pathogens. Other key roles include maintenance of GI barrier function and maintenance of a healthy microbial population.

The sIgA result is below range (<930 ug/gm) for the reference distribution. Low sIgA levels can be seen in association with chronic stress, malnutrition/dietary restriction, congenital deficiency, excessive alcohol intake, chronic nonsteroidal anti-inflammatory use, use of glucocorticoids and antibiotics.

Serum total IgA testing may be indicated if a congenital abnormality is suspected.

Low sIgA is not diagnostic of any clinical condition. Repeat testing may be helpful in the assessment of various interrventions such as dietary modification, and pre-/probiotic therapies.

Henderson, P., et al. Function of the intestinal epithelium and its dysregulation in inflammatory bowel disease. Inflamm Bowel DIs. 2011. 17:382-395.