BEER TESTING SERVICES

BY

MaryGold Laboratories, LLC.

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Edit: April 2017

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About this Guide

The purpose of this catalog is to describe the services offered by MaryGold Laboratories, LLC. ("The Lab" henceforth). Furthermore, the descriptions contained herein are aimed at educating brewers about beer testing: What are these tests? And, why test at all?

*** - For all references about TTB and/or FDA regulations within this document, please refer to original FDA and TTB publications for specific values and exact legislature—Links: TTB, FDA. Please see our website for a complete and up-to-date list of Terms & Conditions. By ordering any tests listed in this catalog and submitting a sample, you agree to MaryGold Laboratories LLC., Terms & Conditions.

About Us

By 2015 the craft brewing community in Central Arkansas was blooming. It became apparent that modern scientific techniques were necessary to provide professional-level quality control. Additionally, the FDA and TTB began regulatory involvement in the craft brewing industry. MaryGold Laboratories was born to allay some of these industry growing pains. Launching services in 2017, MaryGold offers beer testing nationwide. Led by Ithay Biton, a biologist with over 20 years lab experience, MaryGold employs several promising biotechnology graduates. We are equipped with cutting edge instruments, and have taken the time to establish thorough testing techniques, while pruning outdated and inconsistent methods. Simply put, MaryGold Labs offers the craft brewer one powerful tool – information – removing the guess work out of the brewing process. We empirically quantify the chemistry, smell, taste, and color of your brew; so you can use this knowledge to create a safe, consistent product to be proud of.

Lab-Work Processing

Orders and Invoices

Before any order can be processed, we must receive a completed order form. First-time customers must pay in advance; cash, credit cards, and checks are accepted. Invoices are emailed to clients upon agreement of order terms; hard copies may also be provided upon request. Test results are typically completed within three(3) days of sample receipt, with a maximum of five(5) business days. All results and reports are confidential and for the exclusive use of the client. Consultation based on the reports is available from our staff. For detailed processing and confidentiality statements see the Terms and Policies section on our website.

Pricing and Payments

Our updated prices are available on our website, www.marygoldlab.com under the “Pricing” section. MaryGold Labs LLC., reserves the right to change listed prices at any time. Prices listed are for single samples only.

Sample Submission and Shipping

Local Submission

If you are near our headquarters in Little Rock, AR, you may deliver the samples in person to avoid shipping and handling fees. Alternatively, we are also able to pick up your samples locally—check our website “Pricing” table.

The advantages of direct interaction with us regarding shipping are considerable:

- You save on large shipping costs and get results much faster, avoiding long shipping times.
- Unfavorable temperatures during beer shipping are avoided, ensuring your beer is tested properly.

General Shipping

MaryGold Labs aims to make QC and chemical testing services available to any and all interested brewers. If you are not located in central Arkansas, please follow these shipping procedures to ensure safe and sufficient sample submission:

- All packages shipped to MaryGold Laboratories must be marked “Not for Human Consumption,” “Fragile,” and “This Side Up” in the appropriate direction.
- Two standard twelve-ounce bottles of sample brew should be enough for most tests.
    - If you are requesting numerous tests, please consult us about the appropriate sample volume.

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Tests Provided by MaryGold Labs

I. FDA/TTB Compliance Package

The FDA and TTB are invested in providing nutritional information for consumers of craft-brewed beer. To help you comply with the 2017 nutritional labeling guidelines, we have compiled the necessary tests into this Compliance Package.

Alcohol Content

ABV(Alcohol by Volume) is required by TTB regulation***. In a brewery, ABV is measured using a hydrometer. However, measurements with a hydrometer are not accurate enough for the TTB, which mandates precision within 0.2%(v/v). Accepted methods include gas chromatography, and distillation followed by density analysis.

Carbohydrates

When malted grains are boiled starches are broken down into simple sugars. Then, during fermentation, yeast utilize these sugars and create alcohol. Carbohydrates in beer are the sugars that remain after fermentation. The Lab measures carbohydrate content via colorimetric tests on a spectrophotometer.

Calories

The FDA requires*** caloric content on beer nutritional labels. The Lab calculates calories using measured values: alcohol, carbohydrate, protein, and fat content.

Sulfur Dioxide

Any concentration of Sulfur Dioxide higher than 10 ppm must be reported in accordance with the TTB. Concentrations above 350 ppm are unsafe for human consumption according to the CDC. Sulfur dioxide is an **allergen**, has a strong aroma, and a low taste threshold. The smell and taste of sulfur dioxide can be detected even in miniscule amounts - when present in concentrations of parts per *billion*. When it comes to beer, Sulfur compounds are one of the primary causes of “off flavors”, especially in lighter beer.

Total Fat

The total fat content of a standard beer consisting of barley, water, and hops is expected to have a value of 0. The Lab’s calorie calculations (See: Calories) use a value of 0 for fat content. However, some recipes, like milk stouts, may contain some degree of total fat. In such cases, please notify the Lab so this may be tested and included in calculations.

Total Protein

Protein content in beer affects viscosity, foam stability, and haze formation. Total protein is typically listed on nutrition labels, and is used in the Lab’s Calories calculations. The Lab analyzes protein content via an enzymatic assay. On average, a domestic 12-oz beer contains 1.6g of protein.

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II. Contamination

Contamination is the presence of foreign microbes like *Lactobacillus, Megasphaera, Pectinatus,* and *Pediococcus*. These microbes propagate inside the container, cause “off flavors”, and spoil the brew. Microbe management and contamination testing is critical for quality assurance, maintaining a consistent and reproducible final product, and of course for consumer safety.

Bacterial Presence

Using a sterile laminar hood and specialized media, the Lab attempts to grow any spoilage bacteria that may be present in your sample. Visible colonies suggest contamination at specific points in the brewing process, depending on the bacterial strain. The specific bacterial strain, however, must be identified via additional testing—see “Species Identification”.

Species Identification

If spoilage bacteria have been found using our Bacterial Presence test, the species of the bacteria can then be identified. The Lab uses a DNA-based technique called Polymerase Chain Reaction (PCR) to identify the culprit. Different species are very specific to certain types of environments. So, knowing the strain of bacteria present, Lab specialists can deduce the likely source of the contamination in the brewing process.

III. Yeast Health and Growth

At the heart of a great brew is a great yeast strain. Contributing to flavor, color, and alcohol intensity, yeast is primarily responsible for the consistency of your finished product. We provide several tests to assess the growth and efficiency of your yeast, as well as reliable long-term storage. Brewers looking to troubleshoot brewing problems or change their active yeast strains are encouraged to use the Lab’s yeast health, growth, and efficiency testing as a starting point.

Free Amino Nitrogen—FAN Testing

Yeast requires Nitrogen to grow. Free Amino Nitrogen (FAN) represents the concentration of usable Nitrogen from amino acids and small peptides. Excess FAN can cause flavor, microbial instability, and even spoilage. Excess FAN can also be further metabolized into higher alcohols like isoamyl, propanol, and isobutanol—which may taste reminiscent of paint thinner. A FAN insufficiency, on the other hand, can cause slower fermentation, off-flavors, and sweetness levels too high for standard beer. Ultimately, Free Amino Nitrogen in the wort is a good indicator of beer quality and stability, as well as yeast health, growth, and viability. Healthy levels of FAN in wort range from 150-300 ppm, 85% of which should be consumed by the end of fermentation.

Yeast Characterization/Morphology

Foreign yeasts can sometimes contaminate your beer, yielding an inconsistent product. By using meticulous microscopy, the Lab identifies the morphology of any yeast strains present in the sample, and calculates the percent composition thereof. This test verifies that the brewer is, indeed, using the yeast they intend; and further ensures consistency in the finished product.

Yeast Count and Viability

A yeast count determines the amount of healthy yeast cells in a given sample. This value is used (1) to calculate how much yeast is used for initial pitching, (2) to ensure the yeast is thriving, and (3) to verify that the yeast is reproducing sufficiently for the fermentation process. Yeast counts are carried out using a light microscope and Methylene Blue, which marks dead cells to facilitate counting of live cells.

Yeast Efficiency
Yeast efficiency is a measurement of how well yeast converts sugars into ethanol. How fast and how much of a known amount of sugar is converted (by your yeast) into alcohol? Inefficient yeast lead to lower levels of ethanol and higher levels of residual sugars in the beer. Thus, yeast efficiency is critical in relation to the intended style of beer.

Yeast Storage
Modern brewery practices can be very inhospitable to yeast health. Therefore, yeast is typically stored to preserve a specific strain, or to provide a backup incase in-house cultures become unusable. By storing yeast in a glycerol solution and freezing it at -80°C, the strain can be preserved almost indefinitely. When you require the yeast again, contact the Lab for "Yeast Revival".

Yeast Revival
Frozen yeast strains stored by the Lab can be revived for continued use. Your sample will be frozen at -80°C in aliquots (1-2ml), and available upon request. You may then regrow the yeast in-house at 30°C for repitching. Alternatively you may request the Lab to perform the revival, in which case please contact us for pricing.

IV. Brew Profiling and Progression

Brewing is both an art and a science. Your beer has distinct aromas, color, foam structure, hints, and aftertastes you've labored to perfect—and we at MaryGold can quantify those characteristics with concrete, consistent, and usable data. Listed below are tests that take the guesswork out of your brewing process. Tailor your finished beer, develop new flavor profiles, or alter existing ones without deviating from quality. Find out exactly what attributes are most prominent in your most successful brews! What's the chemistry like in your beer?

Acetaldehyde
Acetaldehyde is an organic compound that occurs widely in nature: coffee, bread, and fruit for example. During the breakdown of glucose into ethanol, yeast generates acetaldehyde; it is also produced by the liver when metabolizing ethanol. Excess amounts of acetaldehyde in beer create "off flavors" reminiscent of green apple and dry cider. Acetaldehyde is a contributing factor for hangovers, but most importantly, it is a carcinogen. Although the FDA currently lists acetaldehyde as a safe flavorant, we recommend to keep its concentration as low as technologically possible.

Bitterness
Bitterness in beer comes from *Humulus Lupulus,* the hops flower. The alpha-acids that are extracted from the flower are what create that iconic bitter taste in beers like India Pale Ales (IPA's). Furthermore, hops act as a preservative and have antimicrobial properties. The Lab uses capillary column extraction to quantify the bittering components in the sample. Reports are provided in IBU's (international bitterness units), which represent the concentration of hops acid in parts per million (ppm).

Color

Beer color is the first characteristic noticed by customers, and is usually an indicator of the style and flavor of the brew. Color originates mainly from the malt, pH, wort boiling, yeast strain, fermentation, oxidation, colorants (like caramel), and filtering. Color is measured via spectrophotometer, and reported in EBC(European) or SRM(American) units. To convert between the European and American unit systems use the following equation: SRM=EBC*(0.508). The most common beer color is a pale amber, EBC ~ 12.

pH

pH is a measurement of acidity. This measurement is critical because particular enzymes, yeasts, and brewing reactions all require a specific pH range to function effectively. In beer, low pH is often an indicator of lactic acid formation by contaminant bacteria like *Lactobacillus*. However, sometimes *Lactobacillus* is added to a specialty brew to achieve a desired taste, in which case pH may be used for confirmation.

Polyphenols

Polyphenols in beer are important because of their antioxidant properties, role in haze formation, and colloidal stability—in essence: the look of beer. Polyphenols also contribute to astringency, an essence of “dryness”, in the beer. Many polyphenols have been linked to the prevention of cancer and cardiovascular disease. For the craft brewer, polyphenol management requires a delicate balance—too much or too little can cause “off flavors”, or create a “murky” beer. Finally, shelf-life is also affected by polyphenol content.

ß-Glucans

Beta-glucans are important because of their role in haze formation and the viscosity of the beer. Beta-glucans are glucose polymers present in the cell-walls of barley and malt, similar to starch in structure. Although largely contributing to brew turbidity, proper management of beta-glucans is also essential to the brewing process, as it can cause slow run-off from your mash, clog process filters, or even impede the production of fermentable sugars during mashing.