
Food TBARS Assay



Catalogue Number: FS50

This test is sufficient for assaying 50 samples/standards and 50 sample blanks.

FOR RESEARCH USE ONLY

Not For Diagnostic Use

PRECAUTIONS AND STORAGE

Carefully read and understand these instructions before beginning any testing. This kit is for research use only, and is not for diagnostic use or for use in humans.

Wearing appropriate personal protective equipment such as gloves, lab coat and eye protection is highly recommended. Contacting the dimethylsulfoxide (DMSO) acid solutions in this kit may cause irritation and burning. In case of contact with skin or eyes, immediately rinse with plenty of water for 15 minutes and consult a physician.

This kit will perform as specified if the standard is stored at 4°C until the date printed on the outside of the box.

IF YOU HAVE PROBLEMS

Technical Service Contact Information

Phone: 888.560.7854
E-Mail: info@foodqualitytesting.com
Hours: M-F 8:30 AM to 5:00 PM EST

For us to serve you best, please have the lot number from the kit ready for us to reference.

MATERIALS NEEDED BUT NOT SUPPLIED

1. A spectrophotometer capable of measuring absorbance at 532nm
2. A 1.0 mL pipette
3. Doubly-distilled, HPLC grade, or deionized water at room temperature
4. 15 or 25 mL centrifuge tubes
5. Centrifuge with speeds up to 15,000 × g
6. Tissue homogenizer

Optional:

1. Saturated salt water solution
2. Glacial (concentrated) acetic acid

INTRODUCTION

Off-flavor odor development in lipids and lipid-containing foods is commonly attributed to the by-products of lipid peroxidation. Fats, oils, and other lipids react with oxygen to form peroxides, which then further decompose to give aldehydes, including malonaldehyde (MDA) and hexanal – both of which are associated with deterioration in meats.¹ Factors affecting the formation of lipid peroxidation products include how the product was stored, cooked, processed, and the addition of preservatives.²

The traditional method used for detecting malonaldehyde is the 2-Thiobarbituric Acid Reactive Substances (TBARS) assay. In this reaction, shown below in **Figure 1**, one molecule of malonaldehyde is condensed with two molecules of 2-thiobarbituric acid under heated acidic conditions to form a pink chromogen. This assay has been modified many times since its discovery in the early 1960's and has always required heating to approximately 100°C for longer than 30 minutes with a strong acid. Heating biological samples in an acidic solution generates colors that interfere with the TBARS assay and generates artificially high MDA values.

The FQT Malonaldehyde Quantitation Kit is the first rapid TBARS assay that does not require heating. This feature makes the test more specific for malonaldehyde by greatly reducing the interferences generated by heating. The reaction is complete in 60 minutes at room temperature, and requires no preliminary extraction or distillation.

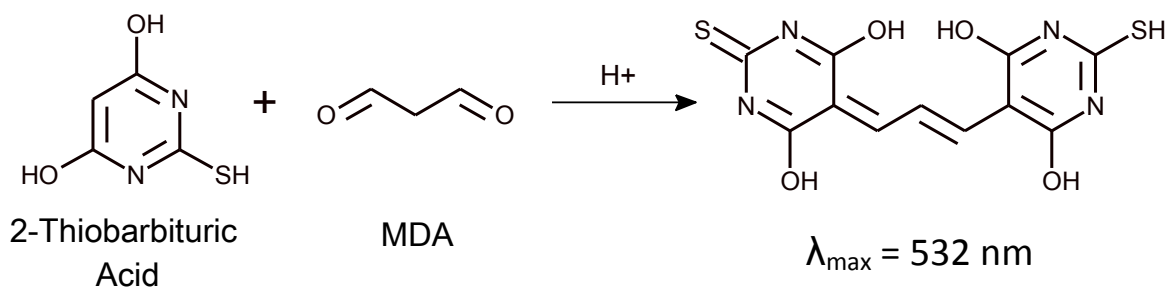


Figure 1: Reaction between 2-thiobarbituric acid and malonaldehyde.

KIT COMPONENTS

Acid Solution:	Two bottles containing 50-mL of a proprietary acid catalyst dissolved in dimethylsulfoxide.
TBA Reagent:	One bottle containing 2.5 g of 2-thiobarbituric acid.
Standard Solution:	Two vials containing 1.1 mL of malonaldehyde tetrabutylammonium salt, 30.0 mg/L MDA in buffer, sufficient for two standard curves.

REAGENT PREPARATION

Except for the 30.0 mg/L MDA standard which should be stored at 4°C upon receipt, the kit is shipped ready-to-use and can be stored at room temperature. Several minutes prior to running the assay, the following solutions should be prepared:

1. Add the 2.5 g bottle of **TBA Reagent** to one bottle of **Acid Solution** and mix well to make the **Indicator Solution***. This is enough solution to perform fifty tests using 1.0 mL of solution for each sample/standard. This solution is stable for one week at 4°C and for one day at room temperature. The solution should appear near colorless when freshly prepared and will slowly turn yellow as it ages. Please note that the DMSO solution will solidify slightly below room temperature and should be thawed completely before use.
2. The **Acid Solution** is ready for use as supplied. Without **TBA Reagent** added, this is the **Blank Solution**.
3. **3.0 mg/L MDA Standard Stock:** Dilute the 30.0 mg/L MDA Standard 1:10 in deionized water by adding 1.0 mL of the 30.0 mg/L MDA **Standard Solution** to 9.0 mL of deionized water. Prepare immediately prior to use.

*If only a few samples are to be analyzed, then 0.5 g of 2-thiobarbituric acid can be added to 10 mL of the **Acid Solution**.

A WORD ON SAMPLE BLANKS...

The reason that a Sample Blank is used in this kit can be summarized as follows: “The ideal blank contains all the sample constituents except the analyte. In practice, the blank is treated as identically to the sample as possible”.³

It is up to the user to decide if a sample blank is necessary. If a sample absorbs at 532 nm before running the TBARS reaction, a sample blank should be run (please read “Interferences” under **TECHNICAL NOTES** at the end of this insert). This can usually be

determined by simply looking at the sample and seeing if it appears to be red or pink in color. If in doubt, prepare a solution by centrifuging a homogenate of the sample in water and find its absorbance at 532 nm.

Some samples have very little, if any, absorbance at 532 nm, such as cooking oils. It is possible to run the TBARS assay on this type of sample without running a sample blank.

SAMPLE AND STANDARD PREPARATION

SAMPLE PREPARATION

There are many different sample types which can be analyzed using this kit. The scientists at FQT have run analyses on a variety of foods, with a summary shown below. Please note that running samples in *triplicate* is highly recommended.

PROTEIN-CONTAINING SAMPLES (meats, fish, nuts)

1. Add 5.0 g of the sample to 5.0 mL of deionized water in a 15 mL centrifuge tube.
2. Homogenize the sample to a smooth suspension.
3. Add enough water to bring the volume to exactly 10 mL.
4. The sample has a solids concentration of 500 g/L and a dilution factor of TWO.

OILS and OILY EMULSIONS (frying oil, mayonnaise, sauces)

1. Add 1.0 mL of the sample to 1.0 mL of deionized water in a 15 mL centrifuge tube.
2. Since DMSO is not miscible with oils, there is no dilution factor as the MDA is extracted into the water/DMSO layer when the assay is performed.

SOLID FATS (shortening, lard, cheese)

1. Add 5.0 g of the sample to 5.0 mL of deionized water in a 15 mL centrifuge tube.
2. Homogenize the sample to a smooth emulsion.
3. Add enough water to bring the volume to exactly 10 mL.
4. The sample has a solids concentration of 500 g/L and a dilution factor of TWO.

DRY INGREDIENTS (cereals, grains, dehydrated products)

1. Add 5.0 g of the sample to 10.0 mL of deionized water in a 25 mL centrifuge tube.
2. Homogenize the sample to a smooth suspension.
3. Add enough water to bring the volume to exactly 15 mL.
4. This sample has a solids concentration of 333.3 g/L and a dilution factor of THREE.

WATER-BASED LIQUIDS (juices, beverages, extracts, milk)

- These samples are run as-is.

HEMOGLOBIN-CONTAINING SAMPLES (blood, bone marrow, liver)

1. Add 5.0 g of the sample to 10.0 mL of deionized water in a 25 mL centrifuge tube.
2. Homogenize the sample to a smooth suspension.
3. Add enough water to bring the volume to exactly 15 mL.
4. Add 1.0 mL of the suspension to 1.0 mL of saturated salt water and 1.0 mL of concentrated acetic acid; mix well.
5. The homogenized and salt water/acid treated sample has a solids concentration of 111.1 g/L and a dilution factor of NINE.

STANDARD CURVE

STANDARD PREPARATION

After dilution, the standard solutions should be used within one day and then discarded, as they are sensitive to oxygen. Malondialdehyde is provided as a solution of the malondialdehyde tetrabutylammonium salt in a slightly basic buffer because MDA itself is not stable. When mixed with the acidic Indicator Solution, the MDA salt is acidified and generates MDA quantitatively. **Table 1**, below, shows the standards and their respective concentrations.

Standard	MDA Concentration, mg/L
S0	0
S1	0.047
S2	0.094
S3	0.188
S4	0.375
S5	0.75
S6	1.5
S7	3.0

Table 1. Standard concentrations.

Procedure:

1. Label eight test tubes **S0** to **S7**.
2. Into tube **S7**, add 1.0 mL of the 3.0 mg/L MDA Stock Solution and set aside.
3. Into tubes **S6** thru **S0**, add 1.0 mL of deionized water and set tube **S0** aside.
4. Take 1.0 mL of the stock 3.0 mg/L MDA Stock Solution, add it to tube **S6** and mix.
5. Remove 1.0 mL of **S6**, add it to tube **S5** and mix.
6. Remove 1.0 mL of **S5**, add it to tube **S4** and mix.
7. Remove 1.0 mL of **S4**, add it to tube **S3** and mix.
8. Remove 1.0 mL of **S3**, add it to tube **S2** and mix.
9. Remove 1.0 mL of **S2**, add it to tube **S1** and mix.
10. Remove 1.0 mL of this solution, leaving 1.0 mL in the tube and discard the excess.

RUNNING SAMPLES AND STANDARDS

MIXING SAMPLES AND STANDARDS: *It is very important that the standards and samples are mixed with the Indicator Solution at the same time. Do not run the Standard Curve and Samples separately.*

STANDARDS

1. Add 1.0 mL of the Indicator Solution to each tube and mix well. Tube **S7** should become noticeably pink within one minute of mixing.
2. Allow to react for 60 minutes.
3. Blank the **S0** standard to set it to zero.
4. Transfer enough of the solution (ca. 1.0 mL) into a cuvette and read at 532 nm.

SAMPLES

PROTEIN-CONTAINING SAMPLES (meats, fish)

1. **Sample :** Add 1.0 mL of the **Indicator Solution** to 1.0 mL of the emulsion.
Blank : Add 1.0 mL of the **Blank Solution** to 1.0 mL of the emulsion.
2. Vigorously agitate the sample for one minute with a vortex mixer.
3. Allow the sample to react for 60 minutes at room temperature.
4. Centrifuge the tube at 15,000 × g and 22-25°C for 5 minutes. Carefully remove the lower aqueous layer being careful not to remove any solids which may skew the data.
5. Transfer solution to a cuvette and measure the absorbance at 532 nm.

OILS and OILY EMULSIONS (frying oil, mayonnaise, sauces)

1. **Sample :** Add 1.0 mL of **Indicator Solution** to the tube containing 1.0 mL each of oil and water.
Blank : Add 1.0 mL of the **Blank Solution** to the second tube containing 1.0 mL each of oil and water.
2. Vigorously agitate the mixture for one minute with a vortex mixer.
3. Allow the sample to react for 60 minutes at room temperature.
4. Centrifuge the tube at 15,000 × g and 22-25°C for 5 minutes.
5. Carefully remove the lower aqueous layer from beneath the top oily layer and place into a cuvette, taking care not to get oil droplets on the sides of the cuvette which may skew the data.
6. Transfer solution to a cuvette and measure the absorbance at 532 nm.

SOLID FATS (shortening, lard, cheeses)

1. **Sample :** Add 1.0 mL of **Indicator Solution** to 1.0 mL of the emulsion.
Blank : Add 1.0 mL of the **Blank Solution** to 1.0 mL of the emulsion.
3. Vigorously agitate the sample for one minute with a vortex mixer.
4. Allow the sample to react for 60 minutes at room temperature.

5. Centrifuge the tube at $15,000 \times g$ and $22-25^{\circ}\text{C}$ for 5 minutes. Carefully remove the bottom aqueous layer being careful not to remove any solids which may skew the data.
6. Transfer solution to a cuvette and measure the absorbance at 532 nm.

DRY INGREDIENTS (cereals, grains, dehydrated products)

1. **Sample:** Add 1.0 mL of **Indicator Solution** to 1.0 mL of the suspension.
Blank: Add 1.0 mL of the **Blank Solution** to 1.0 mL of the suspension.
2. Vigorously agitate the sample for one minute with a vortex mixer.
3. Allow the sample to react for 60 minutes at room temperature.
4. Centrifuge the tube at $15,000 \times g$ and $22-25^{\circ}\text{C}$ for 5 minutes. Carefully remove the top aqueous layer being careful not to remove any solids which may skew the data.
5. Transfer solution to a cuvette and measure the absorbance at 532 nm.

WATER-BASED LIQUIDS (juices, beverages, extracts, milk)

1. **Sample:** Add 1.0 mL of **Indicator Solution** to 1.0 mL of the sample.
Blank: Add 1.0 mL of the **Blank Solution** to 1.0 mL of the sample.
2. Vigorously agitate the mixture for one minute with a vortex mixer.
3. Allow the sample to react for 60 minutes at room temperature.
4. Centrifuge the tube at $15,000 \times g$ and $22-25^{\circ}\text{C}$ for 5 minutes. If the sample remains cloudy, filter through a 0.2 or 0.45 micron syringe filter directly into the cuvette and measure the absorbance at 532 nm.

HEMOGLOBIN-CONTAINING SAMPLES (blood, bone marrow, liver)

1. **Sample:** Add 1.0 mL of **Indicator Solution** to 1.0 mL of the sample.
Blank: Add 1.0 mL of the **Blank Solution** to 1.0 mL of the sample.
2. Vigorously agitate the mixture for one minute with a vortex mixer.
3. Allow the sample to react for 60 minutes at room temperature.
4. Centrifuge the tube at $15,000 \times g$ and $22-25^{\circ}\text{C}$ for 5 minutes. If the sample remains cloudy, filter through a 0.2 or 0.45 micron syringe filter directly into the cuvette and measure the absorbance at 532 nm.

CALCULATING SAMPLE MDA CONCENTRATIONS

1. Subtract the Sample Blank absorbance from the Sample absorbance to obtain a Net absorbance for the sample. If no Sample Blank was run, skip this step.
2. Plot a standard curve using the absorbance value for each Standard versus the MDA concentration for each Standard. The equation of the line can be found using a linear fit method shown in **Figure 2**, on the following page.

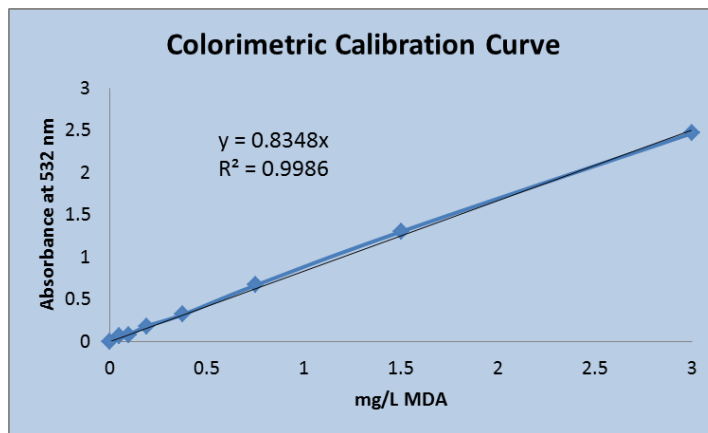


Figure 2: MDA Calibration Curve

- Calculate the MDA concentration for each Sample using the Net absorbance value and the equation generated by the Standard Curve.

EXAMPLE: Using the equation from the calibration curve shown in **Figure 2**.

$$y = 0.8348x$$

or **Absorbance = 0.8348x**
 which gives:
 $x = \text{Absorbance}/0.8348$
Where (x) equals mg/L of MDA

So a fish sample that gives a net absorbance of 1.5 at 532 nm has a value of 1.79 mg/L of MDA.

- Most samples are run as a homogenate, so the result must be multiplied by the dilution factor specified under the Sample Preparation section. The fish sample was prepared as described under PROTEIN-CONTAINING SAMPLES, so this MDA value should be multiplied by a factor of TWO to give a final value of 3.6 mg MDA/kg of fish.
- The value obtained will be in mg MDA per liter of sample. To convert to micromolar (μM) MDA divide the mg/L value by 0.072.

TECHNICAL NOTES

Interferences

Protein: Some references state that protein is an interfering compound in the TBARS assay. MDA reacts with primary amines on amino acids, forming Schiff bases (imines) which can be hydrolyzed to form free MDA during the TBARS assay. This is not classified as an interference, but the *total* MDA concentration of the sample.

Color: The color of a sample can cause significant interference in the TBARS assay. A sample that appears pink, purple or red may absorb in the 530 nm to 540 nm region. If the concentration of malonaldehyde in the sample is low (ca. 500 nM) and the absorbance of the sample at 532 nm is high, then the spectrophotometer could give a very high signal and may not provide accurate data. Diluting the sample with deionized water and back-calculating to the original concentration can overcome this problem, but may dilute MDA concentration to a point where it is too low to be measured. Also, when the **Blank Solution** is added to a sample, the sample becomes highly acidic and can cause a color change. The only way to insure that the color of a sample does not interfere with the assay is to run a Sample Blank for each assay performed.

EXAMPLE: A raspberry juice sample was measured at 532 nm to have an absorbance of 0.4 AU. When the assay was run, the Sample Blank gave an absorbance of 0.274 AU at 532 nm, while the sample had an absorbance of 0.278, or an effective MDA concentration of 4.7 µg/L MDA. Without the Sample Blank subtraction, the sample would have given a false reading of 333.0 µg/L MDA. This example illustrates how the color of a sample needs to be subtracted from the assay in order to obtain a true MDA concentration.

Reducing Sugars: These compounds contain aldehydes that react with 2-thiobarbituric acid which form adducts with an absorbance in the 450 nm region. Reducing sugars will only interfere with the 532 nm reading if they are in very high concentration (mM range), and include glucose, glyceraldehyde, galactose, lactose and maltose.

References:

1. Hammond, E.G.; White, P.J. A Brief History of Lipid Oxidation. *J. Am. Oil Chem. Soc.* **2011**, *88*, 891–897.
2. Papastergiadis, A.; Mubiru, E.; Van Langenhove, H.; De Meulenaer, B. Malondialdehyde measurement in oxidized foods: evaluation of the spectrophotometric thiobarbituric acid reactive substances (TBARS) test in various foods. *J. Agric. Food Chem.* **2012**, *60*, 1931–1937.
3. Ingle, J.D.Jr.; Crouch, S.R. *Spectrochemical Analysis*; Prentice-Hall: New Jersey, 1988; 5-6.

Warranty and Limitation of Remedy

Food Quality Testing Corp. (FQT) makes no warranty or guarantee of any kind, whether written, oral, expressed or implied that includes without limitation, any warranty of fitness for a particular purpose, suitability and merchantability which extends beyond the description of the reagents/chemicals here. FQT warrants only to the original purchaser that the materials in this kit will meet product specifications at the time of delivery. FQT will complete its delivery obligations with care and handling. Under no circumstances will FQT have any obligation or liability, whether in tort (including negligence) or in contract, for any direct, indirect, consequential or incidental damages, even if FQT is informed about the possibility of their existence. This limitation of liability does not apply in the case of intentional acts or negligence of FQT or its employees.

The Buyer's exclusive remedy and FQT's sole liability shall be limited to a refund of the purchase price of the kit, or at the discretion of FQT, the replacement of the kit at no cost to the buyer, of all material that fails to meet our specifications.

Said refund or replacement is conditional on the Buyer giving written notice to FQT within thirty (30) days of receipt of the material. Failure of Purchaser to give said notice within thirty (30) days shall constitute a waiver by Purchaser of all claims hereunder with respect to said material.