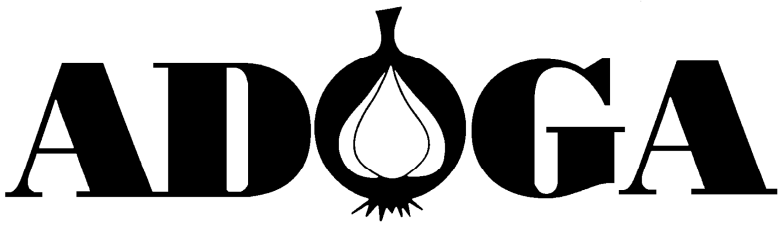

The American Dehydrated Onion and Garlic Association

OFFICIAL STANDARDS AND METHODS

14th Edition,

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ADOGA NEITHER REPRESENTS NOR WARRANTS THAT ANY OF THESE STANDARDS OR METHODS SATISFY OR COMPLY WITH, IN WHOLE OR IN PART, ANY HEALTH AND/OR SAFETY CODES, STATUTES, ORDINANCES, RULES, GUIDELINES OR REGULATIONS REQUIRED OR RECOMMENDED BY ANY FEDERAL STATE OR LOCAL GOVERNMENT AGENCY.

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I. QUALITY POLICY

A. The American Dehydrated Onion and Garlic Association (ADOGA)

ADOGA was established in 1956 as a non-profit, voluntary organization having the following objectives:

1. Standardize qualities and grade specifications within the American dehydrated onion and garlic industry;

2. Adopt uniform nomenclature for the various grades and types of dehydrated onion and garlic products;

3. Support research programs in plant breeding; agricultural practices; and physical, chemical, and microbiological methods of analysis and packaging of dehydrated onion and garlic products; and

4. Improve constantly the standards of excellence for the dehydrated onion and garlic products manufactured by its members.

B. QUALITY - SYSTEM STANDARDS AND PROCEDURE

As part of The American Dehydrated Onion and Garlic Association's (ADOGA's) continuing programs, ADOGA presents these standards and procedures as a service to the food industry. These standards and procedures were originally established as the "Official Standards and Methods" and "Official Microbiological Methods" by the Association's Technical Committee, consisting of one or more representatives from each of the member firms. They have been subsequently revised and are now presented as the "Official Standards and Methods."

II. INSPECTION AND TESTING

MICROBIOLOGY OF DEHYDRATED ONION AND GARLIC

A. General Information

1. In dehydrated onion and garlic, bacteria can be expected because these products are grown in direct contact with soil. These products can be processed in several ways, which may or may not include a process to reduce the microbial load. Although efforts may be employed to reduce the microbial load, total elimination rarely, if ever, occurs.

2. Conventional dehydration does not significantly impact the Aerobic Plate Count. The microbial population in dehydrated onion and garlic can be related directly to the simple concentration of the original resident population of the raw onion or garlic by the dehydration process.

3. Microbiological methods are not as well standardized, as are some chemical or physical testing methods. The microbiological methods are designed to meet the specific requirements of the material being tested, and thus show only that portion of the microbial inhabitants capable of producing visible growth under the standardized conditions. Modification of these conditions of analysis may change the proportion of organisms capable of growth. Since no microbiological methodology has been developed specifically for onion and garlic products, methods have been "adopted" from other procedural manuals. These procedures provide standardized methodology for dehydrated onion and garlic.

4. For specialized methods not listed in these procedures, refer to the Bacteriological Analytical Manual (BAM), which is approved by the U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition. It is available online at http://vm.cfsan.fda.gov/~ebam/bam-toc.html

B. Aerobic Plate Count

1. The Aerobic Plate Count as a routine test provides an estimate of the total number of mesophilic aerobic bacteria in a sample without differentiating among the various types. This analysis can be used as a general index of the bacterial population.

2. The media used for the Aerobic Plate Count and the conditions under which the bacteria are allowed to develop are designed to favor growth of the largest number of organisms.

C. Yeast and Molds

Yeast and molds are widely distributed in the environment. As a result, they may be found in dehydrated onion and garlic products as part of the normal flora. From a practical standpoint, yeast and mold levels can be significant in certain food applications. They should be considered separately

in microbiological analysis. Together with the Aerobic Plate Count, enumeration of yeast and molds provides the general microbiological profile of the product.

D. **Coliforms and *E. coli***

Coliforms are a group of bacteria that at one time were considered by the food industry to be important from the viewpoint of sanitation because some coliforms occur in the intestinal tracts of humans and animals. However, the most frequently isolated coliforms come from the soil or dusty air. Therefore, sanitary significance is no longer attributed to this broad group of bacteria. This is true for non-blanched products, such as dehydrated onion and garlic, which usually do not reach temperatures sufficiently high enough to kill such bacteria. The presence of coliforms in dehydrated onion and garlic does not indicate the presence or absence of pathogenic organisms. Some types of coliform bacteria, however, are found in onion and garlic, which give rise to false positive *E. coli* results unless tested in accordance with standard procedures.

E. *Salmonella*

Salmonella is the causative organism of Salmonellosis. Salmonellosis differs from most other microbiological food borne diseases because the number of organisms necessary to cause symptoms can be low, especially in children and infirm people. This is the reason the FDA has established a zero tolerance. However, this organism is not normally associated with onion and garlic products, but is usually associated with poultry products such as meat and eggs.

The detection of low numbers, if present, is difficult; therefore, pre-enrichment techniques are utilized to detect any viable organism that might be present. When used in combination with modern enzyme immuno assays (ELA, ELISA) current methodology will result in a speedy and accurate test for *Salmonella* species. However, no method has been developed that can guarantee to recover all *Salmonella* serotypes.

Analytical methods must be used in conjunction with a statistically based sampling plan, utilizing a large sample size in order to have a competent and confirmed result.

III. FOOD SAFETY

A. Heavy Metals

Onion and Garlic products are derived from the root bulb of their respective genus. Like other crops, during growth onion and garlic also obtain their nutrients, minerals, and water from the soil. During the growing cycle, heavy metals, present in the soil, are adsorbed into the bulb. Factors that may contribute to the heavy metal content of garlic are 1) soils that contain higher levels of heavy metals due to past use of heavy metal based pesticides and industrial pollution and 2) antiquated processing methods (i.e. coal fired drying) may add heavy metals to these products.

Lead has been the focus of World Health concern for several decades. Many countries have implemented testing programs and limits for lead. As a result, the use of approved or recognized technology is necessary to accurately determine the presence of lead and its levels.

Analytical methods have been developed that determine the levels of heavy metals present in onion and garlic products with limits of detection well into the parts per billion (ppb) range. These analytical methods are designed to meet the specific requirements for the determination of the heavy metal being tested, and thus show only a portion of any heavy metal present. Modification of these methods of analysis may change the accuracy and detectable limits of the tests. Since no analytical methodology has been developed specifically for onion and garlic products, methods have been "adopted" from other procedural manuals. These procedures provide standardized methodology for dehydrated onion and garlic.

Recommended methods include, but are not limited to:

1. ICP MASS SPECTROSCOPY
   Official Methods of Analysis of AOAC International (2003) 17th Ed., Method 993.14, AOAC INTERNATIONAL, Gaithersburg, MD
   Used for Lead, Arsenic, Cadmium

2. GRAPHITE FURNACE METHOD
   Cadrera Et. Al., "Determination of Levels of Lead Contamination in Food and Feed Crops". Journal of AOAC International, Volume 77 (5): 1249-1252 (1994)
   Used for Lead

B. Sulfites

Onion and garlic products derive a significant portion of their flavor and character from sulfur containing compounds. In the United States, ADOGA does not recommend the use of sulfites or sulfiting compounds in the preparation of dehydrated onion or garlic. The most common test for sulfites in foods is the Monier-Williams procedure. However, the Monier-Williams procedure incorrectly reports the sulfur from many naturally occurring sulfur based compounds found in onion and garlic as sulfite.

This can be particularly challenging, because the US FDA requires that the ingredient declaration include any sulfiting agent used if the sulfites present in food exceed 10 ppm. The regulation specifies the Monier-Williams test as the procedure to be used to determine whether a product exceeds 10 ppm. (See 21CFR100.100(a)(4)). The regulation gives specific testing instructions for the procedure to be followed. The procedure is based upon and cites an AOAC International method, which specifically notes this issue.

To improve the accuracy of the Monier Williams methods, the Optimized Monier –Williams was developed. When applied this version improved the determination of sulfite in onion and garlic products but was still subject to incorrectly reporting naturally occurring sulfur compounds and sulfite. The FDA has recognized the existence of these naturally occurring sulfur compounds and has permitted levels as high as 230 ppm to be considered naturally occurring and not subject to labeling requirements.

However, some varieties are higher in sulfur compounds and may generate values higher than 230 ppm. To resolve this issue, a HPLC method, using a C_{18} SPE column, post column derivitization, and UV detection was developed. When utilized, products measured at having sulfite levels above 230 ppm via Optimized Monier Williams but at or below 20 ppm via HPLC are considered natural, without added sulfite, and not subjected to US FDA labeling requirements.

Recommended methods for Sulfite testing:

1. Modified Monier Williams
   Official Methods of Analysis of AOAC International (2003) 17th Ed., AOAC INTERNATIONAL, Gaithersburg, MD

2. HPLC
   G. A. Perfetti and G. W. Diachenko, "Determination of Sulfite in Dried Garlic by Reversed-Phase Ion-Pairing Liquid Chromatography with Post-Column Detection" (2003) JAOAC International 86 (3), 544-550

C. Pesticides

Onion and garlic products are produced directly from field crops. From seed to harvest, independent growers produce their crops adherence to accepted farming practices, processor supervision, and strict compliance to state and federal farming laws. Among these laws is the permitted use of pesticides to ensure an insect and disease free crop is harvested.

Producers maintain their own seed program. As needed and permitted by law, the seeds may receive a pretreatment to prevent insect and fungi infestation. Growers are only allowed to plant seed provided by the producers.

Growers maintain all farming activities, from field preparation, planting, cultivation, irrigation, and permitted use of fertilizers and pesticides. Field representatives maintain communication between the

growers and processors throughout the planting to harvest season. All applications of permitted fertilizers and pesticides and administered in accordance to applicable state and US EPA laws. All fertilizers and pesticides are producer approved and applied under the control of the grower and/or their Pest Control Advisor. All applications are documented with date and rate of application.

There is a long interval between any pesticide application and harvest, including the time required to dry the bulbs and tops. Prior to harvest, a sample is obtained from each grower. This sample is tested at a certified, independent testing lab for organochlorine, organophosphate, organonitrogen and carbamate pesticides. All test results are reported and documented with the State of California.

Upon verification that any residue present is in compliance with applicable State and US EPA tolerances, the processors approve the grower's crop for harvesting and processing.

The direct involvement of the producer, from seed use, through grower monitoring, to approval for harvest, provides for total and complete backward tracking and traceability of their products, from finished product to date of harvest, grower, farming practices and chemical applications, date of planting, and seed of use.

Over the past thirty years, pesticide testing methods have become well standardized. However, as with many chemical and physical testing methods, modifications may be needed due to sample matrix. The pesticide testing methods must be designed to meet the specific requirements of the onions and garlic being tested. These methods must be based on methodology published in recognized reference manuals such as:

1. Official Methods of Analysis of AOAC International (2003) 17th Ed., AOAC INTERNATIONAL, Gaithersburg, MD

IV. RECEIVING INSPECTION AND TEST

Inspection and testing procedures described in this document apply to samples of both dehydrated onion and garlic unless either product is specified. (See Appendix A and B for specifications, nomenclature, quality standards, other attributes, standard packs, and maximum net weights established for dehydrated onion and garlic products, respectively.)

A. Three Class Sampling

The distribution of microorganisms within dehydrated products is not as uniform as many other food products, particularly fluids. Microbiological specifications established by ADOGA are for lot average values. To account for variances around the lot average value, ADOGA recommends the use of the three class sampling plan to define microbiological acceptance criteria for samples taken from a lot upon receipt. * Product testing and process controls within ADOGA member operations have been designed to assure that product will meet these criteria for variability. Because process control sampling and testing with knowledge of the process differs from product acceptance sampling and testing without this knowledge, the actual plans used for product evaluation within each member company may vary from this plan.

Definitions:

n is the number of samples taken from a lot to assess the product
m is the agreed specification used for the product
M is the agreed upon variation used for the product
c is the number of samples which may exceed m but not M

Plan:

n = 5
m = the specification
M = upper limit**
c = 2

Common values for m and M:

Specification (= m)	Upper Sample Limit (= M)
100	310
500	1,600
1,000	3,150
100,000	315,000
200,000	630,000
300,000	950,000
500,000	1,600,000
1,000,000	3,150,000

Thus, for a specification of 100,000, five samples would be taken. Two of the samples could exceed 100,000 but could not exceed the M value of 315,000.

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* This plan does not apply to sampling and testing for *Salmonella* where ICMSF or BAM plans may be applied.

** $M = 10^{((\log m) \times 1.5)}$

B. Microbiological Testing

This section addresses the collection, receipt, setup, and preparation of serial dilutions for Aerobic Plate Count, Coliform and *E. coli*, Yeast and Mold, and *Salmonella* testing.

1. <u>Sample Preparation</u>

a. *General Information*

For each microbiological test (Aerobic Plate Count, Yeast and Mold, Coliform and *E. coli*), prepare a sample homogenate according to procedures below, using materials and equipment specified in paragraph 5 of this section.

b. *Precautions*

Take precautions to prevent microbial contamination of samples from external sources, including the air, and sampling materials and equipment, as follows:

i. Do not touch the inside of the sterile container.

ii. Fill the labeled sample bag no more than 3/4 full.

iii. Seal the bag immediately after the sample is taken.

c. *Receipt of Samples*

i. Check the condition of the sample container for tears, or leakage, which could result in cross contamination that would invalidate the results. If a container is found with a tear, pinhole or leakage, it must be discarded.

ii. Pull a new sample if the container has any tears or pinholes or is leaking.

iii. Check each sample for proper labeling, which includes the following information identified clearly.

1) Sample identification
2) Lot number
3) Shift produced.

iv. Notify your supervisor if the container is not labeled correctly.

v. Wipe down entire workbench surface with microbicide.

vi. Set out the necessary sterile petri dishes, media, Petrifilm, dilution bottles, spatulas, and samples.

vii. Label all dishes and Petrifilm with the sample code and dilution.

viii. Also, label the first plate for each test with the date to be counted.

ix. Record sample numbers, product code, lot numbers, and bulk ID numbers in the lab book.

d. *Preparation of Samples for Microbial Quantification*

Note: Due to the inhibitory compounds in onion and garlic, the use of DE Neutralizing Broth (Difco # 0819-17, Biotrace International BioProducts # BP-0208-500, or equivalent) is required for the initial dilution of all samples.

i. Powder Samples: Blend samples that are in powder form as follows:

1) Use a minimum 10 gram sample size to prepare the initial dilution.

2) Within 10 minutes after the addition of powder, shake the primary dilution 25 times within 7 seconds over a one foot horizontal arc. Alternatively, use a stomacher to mix the primary dilution.

3) Shake subsequent dilutions 15 times within 5 seconds using a 1 foot horizontal arc. Alternatively, use a vortex to prepare subsequent dilutions.
4) Plate the dilutions between 5 - 20 minutes after they have been blended.

ii. Larger Particle Size Samples: Blend samples that have a larger particle size than powder as follows:

1) Weigh out the specified amount of sample into a sterile bag.

2) Add the pre-measured diluent into the bag. Allow at least 5 minutes to elapse before next step is taken.

3) Place the bag into the stomacher.

4) Set the speed to high, and time to 60 seconds.

5) After the completion of the mix cycle, remove the bag that contains the primary dilution. Plate this dilution or prepare subsequent dilutions between 5 - 10 minutes after they have been blended.

6) Prepare serial dilutions by hand shaking 15 times within 5 seconds using a one foot horizontal arc. Alternatively, use a vortex to prepare serial dilutions. Plate these dilutions within 5 - 20 minutes after they have been blended.

e. *Materials and Equipment*

Use the following materials and equipment to prepare samples:

i. Instruments for opening containers as required

ii. Sample transfer instruments

iii. Sterile scoops or spoons

iv. Sample containers

v. Microbicide: Medium strength (110 milligram/liter) hypochlorite solution, 70% Ethanol or equivalent
vi. Sterile stomacher bags

vii. Sterile Butterfield's Buffer or Peptone Water (see Figure 1)

viii. Sterile dilution blanks (see Figure 1)

ix. Seward 400 stomacher or equivalent

x. Balance scale (sensitivity 0.1 gram)

xi. DE Neutralizing Broth (or equivalent)

Figure 1: Preparation of Butterfields Buffer, Dilution Blank, and Peptone Water

Preparation of Butterfields Buffer:

A. Stock Solution

Potassium acid phosphate (KH2 PO4)	34 g
Distilled water	500 ml
Sodium hydroxide (1 normal)	TBD

Dissolve 34 grams of KH2 PO4 to 500 ml of distilled water. Adjust to pH 7.2 with 1 N sodium hydroxide. Bring volume to 1 liter with distilled water.

B. Dilution Blanks

Take 1.25 of stock for Butterfields Buffer and bring volume to 1 liter with distilled water. For 5 gallons of Buffer, use 24 ml of stock solution. Dispense into dilution bottles. Sterilize for 15 minutes at 121^{o}C.

Preparation of 0.1% Peptone Water:
Dissolve 1 g of Bacto Peptone to 1,000 ml distilled or deionized water. Dispense into dilution bottles. Sterilize for 15 minutes at 121^{o}C.

2. **Sample Testing**

Use one of the following testing methods specified in the APHA, BAM, and AOAC* as follows (See Table 1):

Table 1: References for Microbiological Testing Methods

Test	Method	APHA	BAM	AOAC
Aerobic Plate Count	Petrifilm	4.53	---	17.2.07
Aerobic Plate Count	Pour Plate	4.51	Chapter 3	17.2.01
Yeast and Mold	PDA & 10% Tartaric acid	16.52	Chapter 18	---
Yeast and Mold	DRBC	16.51	Chapter 18	---
Coliform and *E. coli*	Petrifilm	24.55	---	17.3.04
Coliform and *E. coli*	Pour Plate	24.54	Chapter 4.I.G	17.3.01
Salmonella	Pre-Enrichment (W/K_2SO_3)	25.514	5.A.10.b	17.9.02(d)
Salmonella	Elisa (Salmonella - Tek™)	25.74	Appendix 1	17.9.11
Salmonella	Conventional	25.52	Chapter 5	17.9.02 and 17.9.03

* APHA: *Compendium of Methods for Microbiological Examination of Foods*, American Public Health Association, 3rd edition, 1992
BAM: *Bacteriological Analytical Manual, FDA*, 8th edition, 2001 (http://vm.cfsan.fda.gov/~ebam/bam-toc.html)
AOAC: *Official Methods of Analysis of the Association of Analytical Chemists*, 17th Edition, 2003

C. Testing for Physical Properties

1. Sample Preparation

For each test below, prepare a sample of product according to the following procedures, using materials and equipment specified:

a. *Humidity:*

Grind and handle product in an environment of no greater than 70% humidity.

b. *Grinding equipment:*

Use grinding equipment to reduce particle size without changing moisture content, for example, using a high speed blender and a 20-mesh screen.

c. *Grinding procedure:*

Place the sample in a blender jar and grind to pass through a 20-mesh screen. Products finer than 20 mesh need not be ground.

2. Test for Yellow Onion

a. *Materials and equipment:*

Use the following materials and equipment to test for yellow onion:

i. 100 milliliter beaker.

ii. 5% sodium hydroxide solution.

b. *Sample preparation:*

Use test sample as is.

c. *Test sample:*

i. Thoroughly mix 1 gram of the sample with 10 milliliters distilled water.

ii. Add 1 milliliter of 5% sodium hydroxide solution and mix thoroughly.

iii. A bright yellow color indicates the presence of yellow onion.

3. Particle Size Analysis

a. *Materials and equipment:*

Use the following materials and equipment to determine particle size:

i. Standard Ro-Tap machine.

ii. 8" diameter screens.

iii. Balance scale (0.1 gram precision).

b. *Sample preparation:*

Use test sample as is.

c. *Test sample:*

i. Weigh 50 grams of product, except powders. Weigh 20 grams of powders to prevent screen blinding.

ii. Place sample on top of stack of screens specified in ADOGA quality standards for particle size.

iii. Shake sample on Ro-Tap for two (2) minutes.

iv. Weigh the product retained on screens and passed through screens.

v. If screen blinding is experienced when screening powders, use screen cleaners.

vi. Multiply product weights by two to express results in percents. For powders, multiply results by five. (See example of particle size analysis, Table 2 below)

Table 2: Example of Particle Size Analysis: Using Tyler Screens on Granulated Onion

Mesh Passed Through	Mesh Retained On	Determination	ADOGA Standards
---	28	Trace	Trace +
28	32	1.0%	5.0% Max
32	100	96.0%	---
100	---	2.6%	6.0%

4. Determination of Moisture (Vacuum Oven Method)

a. *Materials and equipment:*

Use the following materials and equipment to determine moisture content:

i. Aluminum dishes, 3 in dia by 3/4 in with tight fitting aluminum covers.

ii. Analytical Balance.

iii. Air-tight desiccator Drierite Desiccant. A 50/50 mixture of regular Drierite (8 mesh) and indicating Drierite (8 mesh) is recommended for use in both the desiccator and the gas washing system so that its effectiveness can be monitored.

iv. Vacuum oven with fittings for gas washing system, manometer, and thermometer.

v. Gas washing system, connected in series, consisting of a Gilmont No. 10 flowmeter, two 1 liter glass Erlenmeyer flasks, with approximately 400 ml of Drierite desiccant in each, and a Gelman Acro 50, 0.2 micron filter.

b. *Sample preparation:*

Prepare sample according to Section C1.

c. *Test sample:*

i. Tare weigh an aluminum dish and cover. Do not handle aluminum dish or cover with bare hands.
ii. Accurately weigh 2.0000 – 2.5000 g of sample into the dish. Use only enough sample to sufficiently cover the bottom of the dish but not <2g.

iii. Replace cover and store in desiccator until all samples have been weighed.

iv. Before placing dishes in oven, remove lid and place under dish. Place dish and cover in vacuum oven previously warmed to 70 C^{o}. Do not stack dishes in oven.

v. With vent closed, attach gas washing system. Open vacuum and adjust to 26.1 in Hg. During drying open vent and adjust air flow through flowmeter to 60 - 80 ml/min.

vi. Dry for 6 hrs.

vii. Close vacuum.

viii. Disconnect flowmeter from gas washing system. Slowly (approx. 30 - 60 seconds) vent oven through desiccant until pressure returns to 0 in Hg.

ix. Remove sample dishes from oven, replace matching cover and immediately transfer to desiccator to cool.

x. Weigh samples to nearest 0.0001 g.

xi. Calculate percent moisture as follows:

$$\% \text{ Moisture} = \frac{S_O - S_D}{S_O} \times 100$$

Where:

S_O = Original sample weight
S_D = Weight of sample after drying

5. Determination of Extractable Color-Optical Index (OI)

a. *Materials and equipment:*

Use the following materials and equipment to determine OI:

i. Spectrophotometer.

ii. 2 cells.

iii. Wide mouth pint jars.

iv. Ribbed, stemless glass funnel of 4 # 1/4" outside diameter.

v. Analytical balance scale (0.1 milligram precision).

vi. Whatman #2^{v} fluted filter paper (18.5 centimeter).

vii. 100 milliliter burette.

viii. 10% solution of sodium chloride (Reagent Grade).

b. S*ample preparation:*

Prepare sample according to Section C.1.

c. *Test sample:*

i. Weigh two (2.0000 +/- 0.0005) grams for garlic or untoasted onion products or one (1.0000 +/- 0.0005) gram for toasted onion products, and transfer to a wide mouth pint jar. (Depending on the equipment used for measuring optical density, sample weight can be varied so that the readings obtained fall into the optimum range for the instrument. If sample size is varied, adjust final calculations accordingly.)

ii. Measure out 100 milliliters of salt solution, add a small amount of it to the sample, and stir to make a smooth slurry.

iii. Gradually add the rest of the salt solution.

iv. Allow the suspension to stand 15 minutes with occasional stirring.

v. Filter through Whatman #2v filter paper; re-filter several times until solution is clear.

vi. Standardize the instrument at 100% transmittance at 420 NM with the 10% salt solution.

vii. Determine the percentage transmittance (T) of cell with clear filtrate.

viii. Calculate Optical Index based on 1% solution and a 5.0 centimeter cell path, as follows: (Optical density value multiplied by 1,000 converts to Optical Index.)

$$OI = \log \frac{100}{T} x \frac{5 \text{ x } 1,000}{Cell\ path\ used\ , cm \text{ x sample weight , g}}$$

Where: T = % transmittance

6. Determination of Surface Color (Scan)

a. Materials Required

i. Agtron colorimeter, 2 inch (Model M-45) and 6 inch (Model M-35) aperture

ii. Reference disks 00, 90, 56

iii. Agtron Sample cups

iv. Paper tissue

b. Definitions

i. Agtron is a standard reflectance-measuring instrument.

ii. Agtron measures surface color of toasted onion and roasted garlic.

iii. Color is evaluated in the yellow mode.

iv. All non-homogeneous products such as toasted onion flakes and roasted garlic flakes vary in color. The six inch aperture Agtron must be used to insure the variations are minimized during the scan reading

v. All Agtron colorimeters operate in the same basic manner. A light source illuminates the product being analyzed. The reflected light is measured by the light detector to determine the reflected color intensity.

vi. The color measurement process is adversely affected by anything that interferes with light path. The optical parts of the instrument must be kept clean. Sample cups, reference disks, and glass surfaces should be cleaned by soft tissue before and after every test.

vii. Do not leave reference disk or sample cup over viewing window when Agtron is not in use. The UV light from the source discolor the reference disks and causes premature aging. Constant reflected light shortens the life of the electronics.

viii. The reference disks, calibration set points, and color modes vary based on different products and different Agtron machine.

c. Procedure

Note: Calibration checks are to be performed before any SCAN analysis.

i. Select the yellow spectral mode yellow for toasted onion and roasted garlic products.

ii. Place the reference disk 00 on the viewing window and adjust the zero control knob to a meter reading of 0.

iii. Place the reference disk 56 on the viewing window and adjust the standardize control knob to a meter reading according to tables 1 and 2 instruction.

iv. Repeat steps 2 and 3 until the readings coincide. Unit is now ready for normal operation. Fill the sample cup half way and make sure the bottom surface of sample cup is completely covered by sample. Gently tap the sample cup on a soft surface several times, empty spaces between sample particle causes unreliable readings.

Place the filled sample cup on the viewing window and record the reading as SCAN value.

d. Calibration

i. Initial Calibration

1) Allow 45 minutes warm-up time for Agtron M-45, and M-35 models. Follow owner manual recommendation for any other Agtron warm-up time. Start with calibration by disks 00 and 90.

2) Select the yellow spectral mode for onion and garlic products.

3) Place the 00 reference disk on the viewing window and adjust the Zero control knob to a meter reading of 0.

4) Place the 90 reference disk on the viewing window and adjust the Standardize control knob to a meter reading of 100.

5) Repeat steps b and c until the readings coincide.

ii. Product Specific Calibration

1) Allow 45 minutes warm-up time for Agtron M-45, and M-35 models. Follow owner manual recommendation for any other Agtron warm-up time. Calibration by disks 00 and 56.

2) Select the yellow spectral mode for onion and garlic products.

3) Place the 00 reference disk on the viewing window and adjust the Zero control knob to a meter reading of 0.

4) Place the 56 reference disk on the viewing window and adjust the Standardize control knob to the meter reading as specified in Table 1 or Table 2.

5) Repeat steps b and c until the readings coincide.

TABLE 1 AGTRON M-45

Calibration disks and set points for Toasted Onion and Roasted Garlic powder and small piece products: Powders, Granulated, Ground, and Agglomerated	
Disk	Reading
00	0
56	61.5

TABLE 2 AGTRON M-35

Calibration disks and set points for Toasted Onion and Roasted Garlic large piece products: Minced, Chopped, Sliced, Diced, and Flakes:	
Disk	Reading
00	0
56	100

iii. Procedure for calibration disks and inter-instrument agreement

In companies where multiple Agtron machines are used, it is important to ensure that the measurements taken on any of the instrument (different or the same models) are the same.

Several factors can affect the performance of Agtron colorimeters:

- Lamp deterioration
- Internal optical misalignment
- Accumulation of dust or dirt
- Deterioration or variations in the reference disks.

1) Materials required:

a) Reference disk 00

b) Reference disk 90

c) Reference disk 56

d) A Control sample with known SCAN value Standardized by main Agtron machine.

The above reference disks for inter machine calibration must be in like new condition and should never be used for normal production calibration.

2) <u>Calibration</u>

a) Be sure the instrument is warmed up according to manufacturer recommendation.

b) Place the 00 reference disk on the viewing window and adjust the zero control knob to a meter reading of 0.

c) Fill the sample cup half way with control sample of known SCAN value.

Assure the bottom surface of cup is completely covered by control sample. Place the sample cup on the viewing window and adjust the standardize control knob to a reading of control SCAN value.

d) Repeat steps 2 and 3 until the readings coincide.

e) Place the reference disk 56 on the viewing window and record the reading. This value will be the high calibration set point. The low set point will remain 0 from reference disk 00.

7. Hot Water Insoluble Solids (HWI)

a. *Materials and equipment:*

Use the following materials and equipment to determine HWI:

i. Hot plate.

ii. Tall graduated 400 milliliter beakers.

iii. Filter aid (Decalite or equivalent).

iv. Drying oven operating at 105^{o} C.

v. Analytical balance scale (0.1 milligram precision).

vi. Vacuum system and suction flask.

vii. Anti-foam spray.

viii. Gooch crucible.

ix. Whatman #540 filter paper to fit crucibles.

x. Wash bottle with distilled water near boiling.

xi. Stirring rods with rubber policeman.

xii. Desiccator.

b. *Sample preparation:*

Prepare sample according to Section C.1 for powder. Use other samples as is.

c. *Test sample:*

i. Prepare a clean, constant weight gooch crucible containing a disc of Whatman #540 ashless filter paper.

ii. Suspend the sample (2.0000 +/- 0.0005 grams for garlic; 1.5000 +/- 0.0005 grams for onion) in 200 milliliters of distilled water in a tall 400 milliliter beaker.

iii. Add 1.5000 +/- 0.0005 grams of dried filter aid and stir.

iv. Heat to boiling and boil slowly for 5 minutes.

v. Using the vacuum suction system, filter through tared gooch crucible and wash with 200 milliliters distilled water near boiling.

vi. Dry to constant weight at 105 C^o. Cool to room temperature in desiccator before weighing. Weigh sample.

vii. Repeat a blank determination with 1.5000 +/- 0.0005 grams filter aid only.

viii. Calculate HWI, as follows:

$$\% \ HWI = \frac{C_R - C_T - F_S}{S_W} \times 100$$

Where:

C_R = Weight of crucible plus residue
C_T = Tare weight of crucible with filter paper
F_S = Weight of filter aid blank residue
S_W = Sample weight

8. Procedure for Speck Count

a. *Materials and equipment:*

Use the following materials and equipment to determine speck count:

i. Wide view (20-30x) dissecting scope (for products smaller than Minced).

ii. Balance scale to weigh 0.1 gram.

iii. Petri dish with ruled filter paper attached underneath (for sizes Ground, Granulated, and Agglomerated).

iv. Enameled pan for Minced products.

b. *Sample preparation:*

Use test sample as is.

c. *Test sample:*

i. Weigh out sample, as follows:

Product Size	Sample Weight
Coarse Agglomerated Onion or Garlic	0.1 g
Granulated Onion or Garlic	0.1 g
Ground Onion or Garlic	0.5 g
Minced Garlic	10.0 g
Minced Onion	10.0 g

ii. Transfer to petri dish or enamel tray.

iii. Spread uniformly.

iv. Count dark brown or black specks (except Roasted/Toasted products). *Do not count green pigmented pieces as specks.*

9. Defect Counts

a. Classification of Defects:

Use the following classification to identify product defects:

i. Major Defects:

1) ONION:

a) Black pieces.

b) Dark brown pieces (Except Toasted).

c) Seed stems.

d) Sediment or sediment attached to onion.

e) Extraneous vegetable matter (such as tops, rootlet, or other harmless vegetable matter).

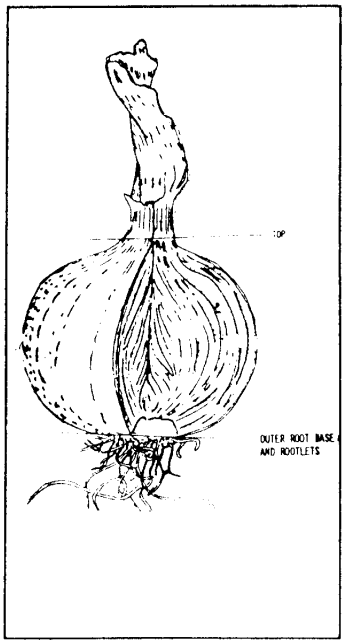
f) Outer root (root base of the onion whether or not rootlets are attached - see Figure 2).

2) GARLIC:

a) Black pieces.

b) Dark brown pieces (except Roasted/Toasted).

Figure 2: Parts of an Onion



c) Roots.

d) Stems.

e) Loose skins.

ii. Minor Defects:

1) GARLIC:

a) Good pieces with small blemishes, light brown pieces.

b) Large attached skins (covering at least ½ the surface of one face of the garlic).

b. *Materials and equipment:*

Use the following materials and equipment to count defects:

i. Balances:

1) 0.1 gram precision for sample weight.

2) 0.01 gram precision for defect weight.

ii. Clean white cardboard sheet.

c. *Sample Preparation:*

Use test sample as is.

d. *Test Sample:*

i. Weigh out sample as follows:

Product	Sample Weight
¼" Diced or Small Chopped Onion	50 g
Chopped Onion or Garlic	100 g
Special Large or Large Chopped Onion or Garlic	100 g
Sliced Onion or Garlic	100 g

ii. Spread weighed sample on white surface.

iii. Carefully pick through the sample, separate defective pieces and weigh major defects groups and minor groups separately. In determining the percent of defective pieces in onion products, break free the defective parts from the onion pieces prior to weighing the defective pieces.

iv. Calculate and report the total defects as percent.

10. Bulk Index

Bulk Index is the volume in milliliters of 100 grams of the product after tapping to constant volume.

a. *Materials and equipment:*

Use the following materials and equipment to determine Bulk Index:

i. Graduated cylinders.

ii. Balance scale (0.1 gram precision).

b. Sample preparation:

Use test sample as is.

c. Test sample:

Add the proper weight of the dehydrated product to the size cylinder listed below and compact by gentle tapping to a constant volume. The tapping required varies for different products. Tapping is considered complete when no loss of volume is observed after the last 50 taps.

Product	Cylinder Size*	Sample Weight
Granulated Onion or	250 ml	100 g
Garlic	250 ml	100 g
Ground Onion or Garlic	500 ml	100 g
Minced Onion or Garlic	500 ml	100 g
Small Chopped Onion	500 ml	100 g
Chopped Onion or Garlic	1,000 ml	100 g
Large Chopped Onion	6" ID	500 g**
Sliced Onion		

* Glass or plastic graduated cylinders comply with the Federal Bureau of Weights and Standards specifications.

Cylinder Size	Allowable Variation in ml
250 ml	1.4
500 ml	2.6
1,000 ml	5.0

** Adjust results according to sample weight.

The use of a mechanical, bulk index machine may be used in lieu of hand tapping. However, the machine must be calibrated to the hand method.

APPENDIX A
DEHYDRATED ONION

I. GRADES

All specifications established for dehydrated onion products are for Fancy grade except in the case of Powdered Onion, for which specifications are also established for Standard Grade.

II. NOMENCLATURE

A. Table 3 lists the standard names of a closely sized series of dehydrated white onion products ranging from the largest to the smallest particle. All American dehydrated onions meeting these standards are made from white varieties. *

B Toasted products carry the same name as white products with the modifier "Toasted," for example, "Toasted Ground Onion, Toasted Sliced Onion".

C Granulated Onion may be a blend of Granulated and Agglomerated for control of Bulk Index. (See Section-IV.C.10)

III. QUALITY STANDARDS

A. *Particle Size*

Table 3 lists the particle size specifications for dehydrated onion products.

TABLE 3: NOMENCLATURE AND PARTICLE SIZE SPECIFICATIONS FOR DEHYDRATED ONION PRODUCTS

The plus ("On") refers to the maximum allowable percentage remaining on the screen; the minus ("Thru") refers to the maximum allowable percentage passing through the screen (See Section IV.C.3).

Tyler Screen	**.525"**	**.371"**	**3**	**4**	**6**	**8**	**10**	**14**	**20**	**28**	**32**	**42**	**48**	**80**	**100**
U.S. Screen	**.530"**	**.375"**	**.265"**	**4**	**6**	**8**	**12**	**16**	**20**	**30**	**35**	**45**	**50**	**80**	**100**
NOMENCLATURE															
Sliced			Thru 90%				Thru 5%								
Large Chopped		** On Tr	On 5%			Thru 30%	Thru 10%								
Special Large Chopped			On 2%		Thru 70%		Thru 10%								
¼" Diced			On 2%			Thru 10%	Thru 5%								
Chopped			On Tr	On 2%		Thru 60%	Thru 10%								
Small Chopped			On Tr	On 2%		Thru 70%	Thru 10%								
Minced				On Tr	On 2%				Thru 3%		Thru 1%				
Ground								On Tr	On 20%				Thru 3%	Thru 1%	
Granulated with suitable anti-caking agent****										On Tr	On 5%				Thru 8%
Granulated										On Tr	On 5%				Thru 6%
Agglomerated – Coarse									On Tr		On 10%				Thru 10%
Agglomerated – Fine												On 2%		On 25%	On 50%
Powdered Products												On 2%		On 25%	On 50%

* Yellow varieties are identified by a single test (see Section IV.C.2)
** Tr - Trace (< 0.1 gram)
*** Small Chopped free of pieces longer than 3/8 inch.
**** For example, 2% Calcium Stearate.

B. *Moisture* (See Section IV.C.4)	Maximum
Toasted Onion Products	3.3%
Untoasted Powdered Onion and Granulated	5.0%
All Other Onion Products	5.5%

C. *Extractable Color (Optical Index)* (See Section IV.C.5)	Maximum
1. *Untoasted Onion Products*	
Fancy Powdered Onion & Granulated Onion	105
Agglomerated Onion ⅄ Coarse & Fine	150
Standard Powdered Onion	150
All Other Dehydrated Onion Products	90
2. *Toasted Onion Products*	Range
All Toasted Onion Products	1300±400

D. *Surface Color (Scan)* (See Section IV.C.6)	Range
1. *Toasted Onion Products*	
Light Onion Powders	69-90
Dark Onion Powders	60-75
Granulated and Ground Onion	40-65
Minced Onion	55-80
Small Chopped Onion	50-70
Special Large Chopped Onion	45-65
Sliced Onion	45-65

E. *Hot Water Insoluble Solids* (See Section IV.C.7)	Maximum
Standard Powdered Onion	30%
All other Onion Products	20%

Note: This test may be applied to any onion product but is of primary value in fine grinds.

F. *Defect Tolerances*

1. *Speck Counts*
   Onion products from Coarse Agglomerated through Minced have the following maximum: (See Section IV.C.8)

	Maximum
Coarse Agglomerated Onion	10/0.1 g
Granulated Onion	15/0.1 g
Ground Onion	15/0.5 g
Minced Onion	10/10 g

2. *Defective Pieces*
   Small Chopped, Chopped, 1/4" Diced, Special Large Chopped, Large Chopped, and Sliced Shall Have a maximum total defect tolerance of 0.5% by weight. (See Section IV.C.9)

G. Heavy Metal (See Section III.A)

a. Lead 100 ppb maximum

H. Sulfites (See Section III.B)

a. Optimized Monier Williams 230 ppm max
b. HPLC (As identified in section III.B.) 20 ppm max

I. Pesticides (See Section III.C)

Compliant to current published State and US EPA permitted use and tolerance.

IV. OTHER ATTRIBUTES

A. *Substitution Ratio or Replacement Values*

In replacing raw onions with dehydrated onions, use the following guidelines:

1. One part by weight of Fancy Powdered, Granulated, or Ground dehydrated onion when used as an ingredient gives approximately the same flavor as 10 parts by weight of prepared fresh market onion of average flavor strength.

2. One part of all other fancy dehydrated onion products when used as an ingredient gives approximately the same flavor as 8 parts by weight of prepared fresh market onion of average flavor strength.

B. *Bulk Index Controlled Products*

Definition: Bulk Index is the volume in milliliters of 100 grams of the product after tapping to constant volume (see Section IV.C.10). Bulk Index control is offered to bottle packers supplying the retail grocery trade. The following ranges are guidelines for customer use prior to establishing their specifications with vendors.

Each product has a natural Bulk Index variation. Bulk Index ranges cannot be controlled tighter than the natural variation. Use the natural variation to establish Bulk Index specifications within the listed minimum/maximum ranges.

Product	Minimum	Maximum	Natural Variation
Granulated Onion.....	110	180	20
Ground Onion	120	180	20
Minced Onion	150	220	20
Small Chopped Onion.....	180	245	20
Chopped Onion.....	180	280	30
Special Large Chopped Onion	270	---	30
Large Chopped Onion.....	300	---	30
Sliced Onion	400	---	50
1/4 " Diced Onion……..	240	310	20

The Association does not recommend setting Bulk Index ranges for onion/garlic powders due to their very complex properties and the fact that powders can be influenced by many variables some of which are: 1) density, composition, moisture, handling and storage, processing, drying, grinding, sieving; 2) content of occluded air inside the particles; 3) cohesion; 4) friction; 5) particle density, size, and distribution; and 6) particle shape and distribution.

V. STANDARD PACKS AND MAXIMUM NET WEIGHTS FOR DEHYDRATED ONION PRODUCTS

Table 4 shows the packs that may be represented as meeting the Association standards. These "moisture barrier" packaging materials are specified to assure storage stability.

Under cool, dry storage conditions, fiber drums, cans, and multiwalled bags will preserve product quality for a minimum of one year; bag in box containers will preserve product quality for a minimum of six months.

TABLE 4: *STANDARD PACKS AND MAXIMUM NET WEIGHTS FOR DEHYDRATED ONION PRODUCTS*

Contents (Maximum net weights in pounds)

"MOISTURE BARRIER" CONTAINERS	Powder	Fine Agg.	Coarse Agg.	Granulated	Ground	Minced	Small Chopped	Chopped	1/4" Diced	Sp. Lg. Chopped	Lg. Chopped	Sliced
55 Gal. Fiber Drum w/ or w/o Poly Liner	250	220	220	250	250	200	175	150	140	125	125	100
26 Gal. Box										60	50	40
10 Gal. Box	50			50	50	40		30	35	25	20	16
5 Gal. Container	25	20	20	25	25	20	18	15	13	12.5	10	8
No. 10 Can*	4			4		3		2.50			2	1.75
1 Gal. Pure-Pak						4		3	2.25		2	1.5
No. 2 1/2 Can*	1			1	1							
16 Fl. Oz. Jar.....				10 oz.								
Multiwalled Bag w/ Moisture Barrier (nominally 1.5 cu. ft.)** ...	60			60	60	50		40	30			

* This is also the minimum weight.
** Multiwalled or other non-rigid containers are available with moisture barrier construction. Consult vendors for details.

APPENDIX B
DEHYDRATED GARLIC

I. GRADES

All specifications established for dehydrated garlic products are for Fancy grade except in the case of Powdered Garlic, for which specifications are also established for Standard Grade.

II. NOMENCLATURE

A. Table 5 lists the standard names of a closely sized series of dehydrated garlic products ranging from the largest to the smallest

B. Roasted products carry the same name as white products with the modifier "Roasted," for example, "Roasted Minced Garlic, Roasted Garlic Powder".

C. Granulated Garlic may be a blend of Granulated and Agglomerated for control of Bulk Index. (See Section IV.C.10)

III. QUALITY STANDARDS

A. *Particle Size*

Table 5 lists the particle size specifications for dehydrated garlic products.

TABLE 5: NOMENCLATURE AND PARTICLE SIZE SPECIFICATIONS FOR DEHYDRATED GARLIC PRODUCTS

The plus ("On") refers to the maximum allowable percentage remaining on the screen; the minus ("Thru") refers to the maximum allowable percentage passing through the screen (See Section IV.C.3).

Tyler Screen	**.525"**	**.371"**	**3**	**4**	**6**	**8**	**10**	**14**	**20**	**28**	**32**	**42**	**48**	**80**	**100**
U.S. Screen	**.530"**	**.375"**	**.265"**	**4**	**6**	**8**	**12**	**16**	**20**	**30**	**35**	**45**	**50**	**80**	**100**
NOMENCLATURE															
Chopped			On Tr	On 2%			Thru 10%								
Minced					On Tr	On 2%			Thru 3%		Thru 1%				
Ground								On Tr	On 20%				Thru 3%	Thru 1%	
Granulated with suitable anti-caking agent**										On Tr	On 5%				Thru 8%
Granulated										On Tr	On 5%				Thru 6%
Agglomerated – Coarse									On Tr		On 10%				Thru 10%
Agglomerated – Fine												On 2%		On 25%	On 50%
Powdered Products												On 2%		On 25%	On 50%

* Tr - Trace (< 0.1 gram)
** For example, 2% Calcium Stearate.

B. *Moisture* (See Section IV.C.4)	Maximum
Roasted/Toasted Garlic Products	5.0%
All Other Garlic Products	6.8%

C. *Extractable Color (Optical Index)* (See Section IV.C.5)	Maximum
1. *Untoasted Garlic Products*	
Fancy Powdered Garlic	150
Agglomerated Garlic - Coarse & Fine	200
Standard Powdered Garlic	200
All Other Dehydrated Garlic Products	200

2. **Roasted/Toasted Garlic Products**	Range
All Roasted Garlic Products	1000±500

D. *Surface Color (Scan)* (See Section IV.C.6)	Range
1. *Roasted Garlic Products*	
Garlic Powders	65-90
Granulated Garlic	40-70
Chopped and Minced Garlic	50-75

E. *Hot Water Insoluble Solids* (See Section IV.C.7)	Maximum
Standard Powdered Garlic	20%
All other Garlic Products	12.5%

F. *Defect Tolerances*

1. *Speck Counts*
Garlic products from Coarse Agglomerated through Minced have the following maximum: (See Section IV.C.8)

	Maximum
Coarse Agglomerated Garlic	13/0.1 g
Granulated Garlic	20/0.1 g
Ground Garlic	20/0.5 g
Minced garlic	13/10 g

	Maximum Percentage by Weight	
2. **Defective Pieces** ***(See Section IV.C.9)***	Major	Minor
Chopped Garlic	1.0%	---

J. Heavy Metal (See Section III.A)

a. Lead — 100 ppb maximum

K. Sulfites (See Section III.B)

a. Optimized Monier Williams — 230 ppm max
b. HPLC (As identified in section III.B.) — 20 ppm max

L. Pesticides (See Section III.C)

Compliant to current published State and US EPA permitted use and tolerance.

IV. OTHER ATTRIBUTES

A. *Substitution Ratio or Replacement Values*

In replacing raw garlic with dehydrated garlic, use the following guidelines:

> One part by weight of Fancy dehydrated Garlic products when used as an ingredient gives approximately the same flavor as five (5) parts by weight of prepared fresh market garlic of average flavor strength.

B. *Bulk Index Controlled Products*

Definition: Bulk Index is the volume in milliliters of 100 grams of the product after tapping to constant volume (see Section IV.C.10). Bulk Index control is offered to bottle packers supplying the retail grocery trade. The following ranges are guidelines for customer use prior to establishing their specifications with vendors.

Each product has a natural Bulk Index variation. Bulk Index ranges cannot be controlled tighter than the natural variation. Use the natural variation to establish Bulk Index specifications within the listed minimum/maximum ranges.

Product	Minimum	Maximum	Natural Variation
Granulated Garlic.....	120	140	20
Ground Garlic	110	150	20
Minced Garlic	120	150	20
Chopped Garlic.....	120	175	30

The Association does not recommend setting Bulk Index ranges for garlic/garlic powders due to their very complex properties and the fact that powders can be influenced by many variables some of which are: 1) density, composition, moisture, handling and storage, processing, drying, grinding, sieving; 2) content of occluded air inside the particles; 3) cohesion; 4) friction; 5) particle density, size, and distribution; and 6) particle shape and distribution.

V. STANDARD PACKS AND MAXIMUM NET WEIGHTS FOR DEHYDRATED GARLIC PRODUCTS

Table 4 shows the packs that may be represented as meeting the Association standards. These "moisture barrier" packaging materials are specified to assure storage stability.

Under cool, dry storage conditions, fiber drums, cans, and multiwalled bags will preserve product quality for a minimum of one year; bag in box containers will preserve product quality for a minimum of six months.

TABLE 6: ***STANDARD PACKS AND MAXIMUM NET WEIGHTS FOR DEHYDRATED GARLIC PRODUCTS***

Contents (Maximum net weights in pounds)

"MOISTURE BARRIER" CONTAINERS	Powder	Fine Agg.	Coarse Agg.	Granulated	Ground	Minced	Chopped.
55 Gal. Fiber Drum w/ or w/o Poly Liner	300	250	225	300	300	300	250
10 Gal. Box	60			60	60	50	50
5 Gal. Container.....	30	25	20	30	305	30	25
No. 10 Can*.....	4.5			4.5			
No. 2 1/2 Can*.....	1			1			
16 Fl. Oz. Jar				12 oz.			
Multiwalled Bag w/ Moisture Barrier (nominally 1.5 cu. ft.)**	50			50	50	50	40

* This is also the minimum weight.
** Multiwalled or other non-rigid containers are available with moisture barrier construction. Consult vendors for details.