Appendix K

National Pasta Association (NPA)

Proposal to Establish a Moisture Allowance for Pasta Products

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September 16, 2009

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c/o Laws & Regulations Committee
National Conference on Weights and Measures
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Joe Benavides
Chairman, Laws & Regulations Committee
Southern Weights and Measures Association
Texas Department of Agriculture
1700 North Congress Avenue, 11th Floor
Austin, TX 78701

Re: Proposal to Establish a Moisture Allowance for Pasta Products

Dear Messrs. Onwiler and Benavides:

The National Pasta Association ("NPA") submits this proposal to request that the National Conference on Weights and Measures ("NCWM") amend Handbook 133 by adopting a 3 percent moisture allowance for macaroni, noodle, and like products ("pasta products"). NPA is the national trade association representing companies that manufacture, market, and distribute pasta throughout the United States. NPA's allied members include wheat producers and millers, companies that manufacture pasta making equipment, and others who support the production of high quality pasta.

The allowance for pasta products has been previously proposed and accepted as reasonable and valid. 1/ Amendment of Handbook 133 will simplify the ability of inspectors to evaluate moisture loss for this discrete class of products. The change will assist jurisdictions in promoting fair trade and equity in the marketplace in a manner that is consistent with applicable law and regulations.

1/ Although referred to herein as an "allowance," NPA's request is for the establishment of a "gray area." Handbook 133 explains this concept as follows: "When the average net weight of a sample is found to be less than the labeled weight, but not more than the boundary of the 'gray area,' the lot is said to be in the 'gray' or 'no decision area.' The gray area is not a tolerance. More information must be collected before lot compliance or noncompliance can be decided. Appropriate enforcement should be taken on packages found short weight and outside of the 'moisture allowance' or 'gray area.'"

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Discussion

A. Background and Legal Basis for Modification of Handbook 133

The Federal Food, Drug, and Cosmetic Act ("FDCA") requires that food packages bear an "accurate" statement of net weight. 2/ States generally have established and enforce an identical requirement. As contemplated by the FDCA, federal regulations also mandate that "reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized." 3/ States impose parallel requirements. The required allowance for moisture loss was recognized by the U.S. Supreme Court in the case of *Jones v. Rath Packing Company*. 4/ Accordingly, inspectors must adjust for moisture loss when determining compliance with the federal and state net weight requirement.

Handbook 133 serves as an important tool that informs jurisdictions' good inspection practices. Currently, Handbook 133 includes specific moisture allowances for meat and poultry, flour, and dry pet food. 5/ No moisture allowances are expressly established for pasta products. For commodities other than those specifically listed, Handbook 133 provides limited guidance on the determination and application of moisture allowances. In recent years, NCWM's Laws and Regulations Committee has considered a series of proposals to address aspects of this issue, leading to formation of a "Working Group." 6/ The lack of guidance specific to pasta products causes challenges for state weights and measures officials across the country when conducting package inspections. Some inspectors mistakenly conclude that the absence of a specific moisture allowance for pasta products in Handbook 133 means that no consideration of moisture loss is necessary or required. That is, of course, not the case.

Over the past two decades, there has been interest in, and a sound factual basis for, establishing an allowance for moisture loss in pasta. A proposed rule issued by the Food and Drug Administration ("FDA") provided the first impetus for NPA's efforts. In 1980, FDA proposed to quantitatively define permissible "reasonable variations" from stated net weights for several food categories, including foods subject to moisture loss. 7/ FDA's proposal only specified a moisture allowance for a limited number of foods. The agency acknowledged the narrow scope of its proposed rule and explained that only a few express allowances were being proposed because FDA had a limited amount of moisture loss data available that were developed under

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2/ 21 U.S.C. § 343(e) (Foods in package form must bear "an accurate statement of the quantity of the contents in terms of weight . . . except that . . . reasonable variations shall be permitted").
3/ 21 C.F.R. § 101.105(q).
4/ *Jones v. Rath Packing Co.*, 430 U.S. 519 (1977).
5/ NIST Handbook 133: Checking the Net Contents of Packaged Goods, at 17.
6/ The Working Group has examined primarily mechanical issues (*e.g.*, when and how to account for moisture loss in the course of an inspection). This proposal advances the current efforts of the Working Group and the Conference's goal in maximizing the utility of Handbook 133 in promoting uniform, well-conceived, good inspection practices.
7/ 45 Fed. Reg. 53023 (Aug. 8, 1980). This proposed rule was later withdrawn. 56 Fed. Reg. 67440 (Dec. 30, 1991).

well-defined conditions. 8/ FDA encouraged interested persons having pertinent data on moisture loss to provide the information to the agency so that additional moisture loss categories could be proposed.

Following FDA's request for data, NPA commissioned a comprehensive study regarding moisture loss in pasta products. The protocol for this study was reviewed and accepted by FDA. NPA submitted the findings of this study to NCWM in 1988. 9/ The conclusions of the study were published and are summarized herein. 10/ The packaging used for pasta products has not changed since this study was conducted, nor have the packing methods or the basic formulations relative to moisture content. The findings of the 1989 study are consistent with more recent, discrete data which validate that the hygroscopic nature of pasta products results in unavoidable moisture loss.

Based on the strength of the pasta industry data submissions, FDA included in a 1997 proposal an express allowance of 3 percent for pasta. 11/ FDA specifically proposed a 3 percent allowance for a number of commodities, including pasta, if more than 7 days had passed following the day of pack. 12/ The proposed rule was ultimately withdrawn after many years of inaction, but not for reasons relating to the merit of the proposed moisture loss allowance for pasta products. 13/

During the 1990s, NIST continued to work toward establishing additional moisture allowances for pasta and certain other products (*e.g.*, rice). 14/ As an interim measure, NIST issued guidance to State Directors to facilitate appropriate recognition of "reasonable" moisture loss. Between 1995 and 2006, NIST issued instructions to weights and measures officials advising them to recognize a 3 percent moisture loss for pasta, rice, and other products not specifically included in Handbook 133. 15/

8/ 45 Fed. Reg. at 53029.

9/ Letter from G. Kushner to R. Thompson, February 2, 1988.

10/ Dick, Joel; Shelke, Kantha; "Net Weight Variation in Packaged Pasta," *Cereal Foods World*, Vol. 34, No. 2, pg. 201 (February 1989).

11/ 62 Fed. Reg. 9826 (Mar. 4, 1997). FDA's proposed establishment of an allowance in this rule did not adopt the "gray area" concept. Although the agency found "considerable merit" in this approach, it determined that it was not viable because there were too few limits established for foods subject to moisture loss at that time. 62 Fed. Reg. at 9850-51.

12/ 62 Fed. Reg. at 9851-52, 9869.

13/ 69 Fed. Reg. 68831, 68837 (Nov. 26, 2004).

14/ 62 Fed. Reg. at 9851 ("[L]imits are being developed for rice and pasta."); Weights and Measures Division Memorandum from Carroll S. Brickenkamp, July 12, 1994 ("Work is underway in the NCWM to develop gray areas for rice and pasta and a wide variety of meat and poultry products."); Weights and Measures Division Memorandum from Gilbert M. Ugiansky, Ph.D., April 3, 1995 (same).

NPA also was actively engaged in moisture loss allowance efforts during the early 1990s. Meetings were held between NPA's Moisture Loss Task Force and NCWM regarding establishment of a gray area for pasta products.

15/ Weights and Measures Division Memorandum from Gilbert M. Ugiansky, Ph.D., April 3, 1995 (concerning the impact of the Nutrition Labeling and Education Act of 1990 ("NLEA") on net content testing by State and local weights and measures officials); Weights and Measures Division Memorandum from Ken Butcher, January 1, 2006 (withdrawn for reasons unrelated to moisture loss guidance).

There is a broad consensus within the Conference, at NIST, and among State Directors and local programs, that it is necessary and appropriate to consider a 3 percent moisture allowance when conducting a Handbook 133 inspection. As a matter of law, such an allowance must be considered and accounted for or the inspection results are invalid and a finding that such pasta products are impermissibly underweight would be invalid (*i.e.*, pasta products should not be ordered off-sale absent consideration of moisture loss). The inevitable changes in institutional knowledge, the influx over time of inspectors, and the challenges of training state and local inspectors all point to the inherent value and need for an express 3 percent moisture allowance for pasta in Handbook 133. Failure to codify this allowance will inevitably lead inspectors to unwittingly "fail" an inspection lot, and order pasta products off retail shelves, for products that bear an accurate statement of net weight. 16/

NCWM has appropriately recognized that the issue of moisture loss is "complex" and, because Handbook 133 currently provides specific guidance on the determination and application of moisture allowances for a limited number of commodities, "[w]eights and measures jurisdictions across the country have been struggling with how to properly handle moisture loss during packaging inspections." 17/ The Work Group was created because "more definite guidance on this issue" is needed for commodities other than those specifically listed. 18/ The Work Group has also recommended that industry petition for specific moisture allowances. NPA heeds this call and has developed this proposal to begin the process of NCWM consideration and ultimate adoption of the addition to Handbook 133 for a 3 percent moisture loss allowance for pasta products.

This proposal surveys the substantial body of data that has been developed regarding moisture loss in pasta products. These data support a moisture allowance up to 5 percent, however NPA is only requesting an allowance of 3 percent. It will remain the responsibility of individual packers to minimize and account for moisture loss, consistent with good manufacturing practices, and to over-pack if anticipated moisture loss exceeds the 3 percent allowance.

B. Pasta Industry Practices

NPA member companies engage in a variety of practices regarding processing, distribution, and net quantity control. The following discussion is a typical example of such processes. Because every company is unique, however, companies may engage in different practices than those discussed herein depending on their specific circumstances. Notwithstanding these differences, the properties of pasta products, the method of packing, the nature of packaging, methods of distribution, and other industry practices that could have an impact on moisture loss are largely consistent.

16/ The practical impact of an erroneous inspection where moisture loss in pasta is not accounted for goes far beyond the retail inspection lot of 12 or more packages. Retailers often will remove the entire lot code from not just one store, but from its entire system.

17/ NCWM Laws and Regulation Committee, 2008 Interim Meeting Agenda, Work Group on Moisture Loss, available at http://www.ncwm.net/pdf/LR-08-Pub15-Final.pdf.

18/ *Id.*

Pasta is produced by an extrusion method of semolina dough made from durum wheat flour and water. The shapes are obtained from a series of dies and inserts and high speed cutters to maintain size and dimension. After various stages of mixing, moisture is removed by a drying process utilizing different levels of heat, humidity, ventilation, and cooling. The dryers are set according to specific profiles that control the rate at which moisture is removed. Final moisture results achieved range from 10.5% to 13%, depending on the pasta shape and production line. Product is typically evaluated for moisture, among other traits, during drying cooling, and after final packaging. As discussed further below, monitoring of all package net weights are performed on individual cartons after the package fill process sealing. Manufacturing takes approximately 3 to 12 hours at the processing stage. The length of time for the drying process depends on the shape but generally ranges from 3 hours to 12 hours. This time varies in conjunction with the processing line and type of product.

After the drying and cooling stage, product is stored short term for packaging. Storage times are typically brief, totaling less than 8 hours. For packaging, the product passes through a set of calibrated scales that feed the bagging or cartoning machine. Sealed, non-airtight product packages are then machine cased into paperboard cases. Typically, a fully automated system sends cartons to case packers and then to fully automated palletizers. Warehouse operators receive possession of the product from the palletizer, scan bar coding, and place the pallets in a racking system where it is held for distribution. Packaging takes between 1 and 3 hours.

Product is stored at ambient temperatures and distributed according to sales orders. Inventory of most products is usually no more than a month, but is also subject to sales orders. Inventory turnover is monitored so that no inventory becomes aged. The lag time between shipment and purchase of the product by a consumer varies greatly, usually taking at least 22 weeks.

Net weight quantity control is monitored using calibrated in-line weight system equipment. Scale systems on all packaging lines are computer monitored and calibrated. The monitoring of these checks, and all aspects of the process that can effect package weights are typically monitored and reviewed to ensure that best packing practices are followed in a given processing plant. Some production lines also make use of "check-weighers" to guard against unanticipated unreasonable variation in package weights. Individual packages that are "kicked-off" the check-weigher due to low weights are segregated and designated for "rework procedures" adopted by the particular packager. In other instances where automation is not as complete, Mettler Balances are used on each packaging line for regular sampling (*e.g.*, every 30 minutes) to verify weights.

Compliance with Handbook 133 is also obtained through planned quality systems and utilization of standard operating procedures. All weighing systems are programmed to meet declared packaged weights in compliance with NIST Handbook 133. Specifically, the average net weight of the run must equal or exceed the package label weight and there must be no single package that exceeds Handbook 133's maximum allowable variance at the time of packaging. Although the weight control program is designed to meet declared weights at point-of-pack, a moisture loss deviation will occur over time, which can be caused by ordinary exposure to conditions that normally occur in good distribution practices. The length of time in distribution, environmental

conditions, and other storage conditions may also contribute to an unavoidable loss in moisture.

C. Published Data Support a 3 Percent Moisture Allowance for Pasta Products

Pasta is made in many geographic locations across the United States and is shipped throughout the country. Although pasta exhibits weight loss in all geographic locations, extremes in climate, altitude, and temperature have a significant impact over time. As well, additional losses result when packages are uncased and placed in an air conditioned or heated retail environment.

Both carton and flexible (plastic) packaging experience moisture loss for pasta, though greater loss occurs in cartons. Industry studies indicate that moisture loss for pasta products is reasonably predictable over time. The degree of loss is inevitably influenced by the environment in which it is stored. The studies summarized below are based both on "real world" data in the retail marketing chain and studies designed to simulate these conditions.

The 1989 study is the result of a thoughtful, comprehensive approach that remains relevant today. The packaging used for pasta products has not changed since this study was conducted, nor have the packing methods. Also, the findings of the 1989 study are consistent with more recent, discrete data.

1. NDSU 1989 Study

A published study (hereinafter "Dick and Shelke study") evaluating the moisture loss of products in a typical retail storage situation recommended the establishment of a net weight allowance of 5.0 percent for pasta packaged in paperboard cartons and 3.2 percent for pasta packaged in flexible bags. 19/ The authors reached this conclusion after reviewing (1) the results of an FDA survey of moisture loss in flour packaged in Kraft paper bags, (2) FDA guidelines for moisture-loss surveys, (3) guidelines offered to the NPA by FDA officials on March 30, 1981, (4) the results of a 1981 NPA Packaging Survey, and (5) the unpublished results of a private manufacturer's research and development study on pasta net weight.

Importantly, NPA conducted the 1981 packaging study in accordance with FDA guidelines for moisture-loss surveys. This study monitored the moisture loss of pasta products in three typical storage sites: a retail supermarket in metropolitan New Jersey, a warehouse in metropolitan New Jersey, and a warehouse in Minneapolis, Minnesota. The retail store was a large air conditioned facility, representative of typical supermarkets used to display the bulk of the pasta sold in the U.S. The moisture loss of the pasta stored in the retail stores and the warehouses ranged from 2.24 to 5.02 percent for the pasta in paperboard packaging and from 1.22 to 3.18 percent for pasta sold in flexible packaging.

Additionally, the Dick and Shelke study reported the results from a private research and development study that monitored moisture loss over a 16-week period under the following controlled conditions: desert (90º F, 10% R.H.), ambient (70º F, 50% R.H.) and tropical (80º F,

19/ Dick, Joel; Shelke, Kantha; "Net Weight Variation in Packaged Pasta," *Cereal Foods World*, Vol. 34, No. 2, pg. 201 (February 1989).

80% R.H.). The pasta had a moisture loss of greater than 6 percent under desert conditions, a moisture loss of greater than 1 percent under ambient conditions, and a moisture gain of greater than 1 percent under tropical conditions.

It is also reported that, because pasta is hygroscopic, it eventually reaches an equilibrium with the surrounding atmosphere. The final equilibrium depends upon the temperature, the relative humidity of the ambient air, and the initial moisture content of the pasta. Further, pasta in paperboard cartons loses weight relatively fast within the first two to three months after production. After that, its weight fluctuates up and down with the change in ambient conditions. Pasta packaged in flexible bags loses weight at a rate which is more gradual and less responsive to change in ambient storage conditions than paperboard cartons.

After reviewing the available data on the moisture loss in pasta, Dick and Shelke concluded that it would be appropriate to establish a net weight allowance of 5.0 percent for pasta packaged in paperboard and 3.2 percent for pasta packaged in flexible bags.

2. Industry Studies on Moisture Loss

The pasta industry has conducted several moisture loss studies in recent years. The results of these studies are consistent with Dick and Shelke and indicate that no technological developments have occurred to alter the validity of Dick and Shelke's findings today. The series of studies discussed below demonstrate a good correlation between moisture loss and weight loss. Given both variation in product age at the time of purchase and the impact of environmental and geographic conditions, loss of weight due to moisture at retail can vary more than 4 percent. Similar losses can be seen in both very dry environments and other areas, depending on product age and local conditions.

The studies, drawn largely from company-specific analyses considered proprietary and confidential, validate the published studies and further support the following conclusions:

- Weight loss in pasta is directly related to moisture loss.
- Moisture loss from the time of production to the customer at the retail outlet shows considerable variation.
- The manufacturer cannot make process adjustments based on average loss in dealing with moisture loss extremes.
- Moisture loss occurs for pasta products that are packed in both film and cartons.
- Pasta products moved from warehouse storage to an air conditioned environment begin to show immediate moisture loss.
- Average weight loss was found to be between 2-3%, but when product was moved into a simulated retail environment, it reached 4% and in extreme cases 5%.

i. Study One: Deviation of Actual Net Weight from Declared Label Weight

One industry study sought to determine, by manufacturer and on the average, how the actual net weight of each sample deviates from the declared label weight. Retail product samples were

collected from five U.S. manufacturers in film and cartons from ten geographic areas throughout the United States. The products were long and short goods in cartons and film and cartons of lasagna. 20/ These samples were sealed in plastic to retain ambient humidity for each geographic area. After shipping to a testing facility, the products were immediately weighed.

In this study, the retail samples collected demonstrated that products packed in paperboard cartons generally weighed less with respect to labeled weight in hot, dry environments and at higher altitudes. Humidity change is part of the reason for variability in moisture loss in different geographical areas. However, not all of the extremes in moisture loss were found in hot, dry, or high altitude locations. This would suggest that the conditions under which pasta is stored and held for sale, among other factors, also influence moisture loss in pasta.

The average retail moisture across brands for products packaged in cartons was roughly 2% below typical production moistures (12+%) and extremes are 4% below. This study did not have access to the actual pack weight at the time of production.

ii. Study Two: Immediate Weight Loss After Production

Another experiment was designed to understand the immediate weight loss after production of pasta products and to simulate the impact of moving product from one warehouse to another in a significantly different geographic region. Three cases of production samples of 5 products in cartons and film were pulled from the production line and weighed at 0 and 3 days and every 7 days thereafter. Initial moisture was also taken. Moistures were also tested every month throughout the testing period. Following 30 days, two of the cases from each shape and package type were shipped to other product plants for continued testing every 7 days. At the end of 60 days, the samples are tested for moisture and weight monthly through 6 months from production. The plants used in the study are located in various regions of the U.S., including the desert and the coasts.

The results of this study show that products packed in film remain reasonably stable with little moisture loss while that in cartons drops by 1-1.5% within the first two weeks following production. This supports the data seen with the retail samples. As this trend continues, weight loss approaches 2.5% at 2 months, on the average, in a warehouse environment, and continues when product is uncased and subjected to a retail environment. Additional testing over the course of a year would, in all probability, show more impact from geography as seasonal low temperature and humidity extremes begin to take effect.

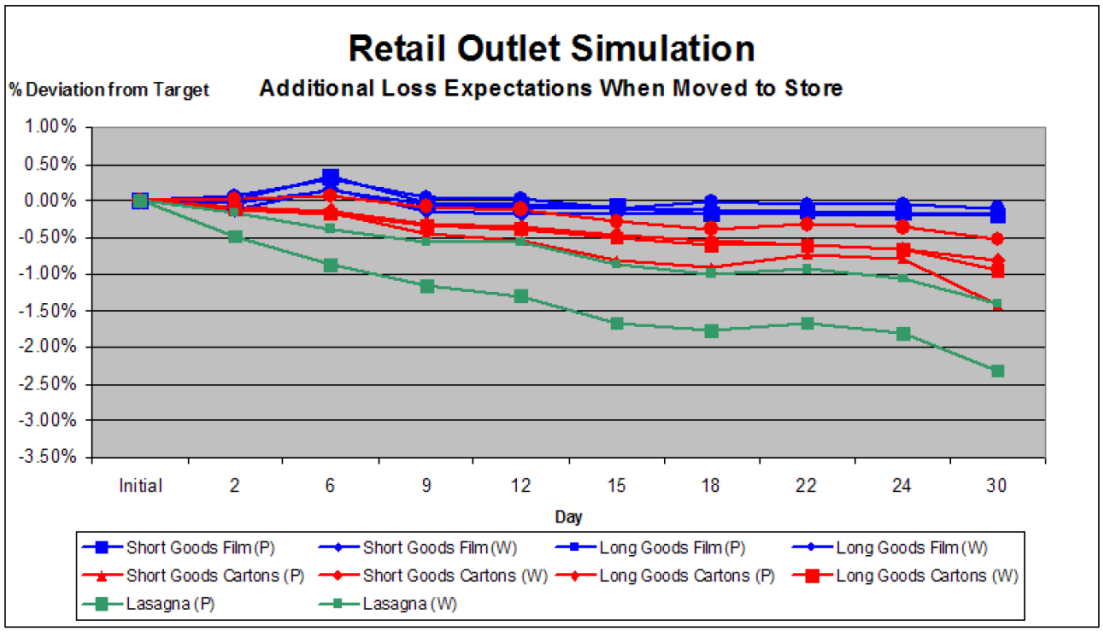
iii. Study Three: Impact of Retail Environment

An additional industry experiment sought to understand over the short-term how package weight changes when moved from a non-climate controlled environment to an air-conditioned retail outlet. In this study, one case of 5 products in cartons and film was pulled from a Midwest production facility and similar cases at least 80 days old were pulled from the production facility

20/ Although lasagna is tested in this study, it is not included in most of the data regarding weight loss in finished packages.

warehouse. All of these cases were moved to an air conditioned environment and weighed initially and every three days for 2 weeks to simulate the retail environment.

The moisture loss in products packaged in cartons ranged between 0.5 and 1.5%. The study also determined that both freshly packed samples ("P" on chart below) and older warehouse samples ("W" on chart below) tend to lose 0.5-1.0% when removed from cases and placed individually in an air conditioned retail environment.



iv. Study Four: Moisture Loss Over Product Life Cycle

Another industry experiment was designed to measure moisture loss over the average life of one company's pasta products through their distribution cycle from packaging to consumer sale. This study was designed to test the "worst case" scenario, using paperboard cartons and conducting the study during the fall and winter, the seasons with the lowest relative humidity in warehouses and retail stores. The pasta was stored at ambient conditions in the distribution system for about 8 weeks and then for another 4 weeks to simulate distribution on its path to the consumer. The product was then held in an air conditioned environment (a plant lab) simulating the store shelf for an additional three weeks. Actual moisture loss over the 15 week study at each location was 2.5% (Midwest), 3.38% (Eastern Seaboard), and 5% (Eastern Canada).

D. Proposed Amendment to Handbook 133

NPA requests that Handbook 133 be amended as follows to incorporate a 3 percent moisture allowance for pasta products, adding the language in bold below:

- On page 17 (in Section 2.3), *Moisture Allowances*:
  - *What is the moisture allowance for flour**, pasta products,** and dry pet food?* The moisture allowance for flour**, pasta products,** and dry pet food is 3% of the labeled net weight.
  - **Note: Pasta products means all macaroni, noodle, and like products packaged in kraft paper bags, paperboard cartons, and/or flexible plastic bags with a moisture content of 13% or less at the time of pack.**

- On page 18 (in Section 2.3), *How is the average error for the moisture allowance corrected?*:
  - This handbook provides "moisture allowances" for some meat and poultry products, flour, **pasta products,** and dry pet food.

- On page 3 (in Section 1.2), *Why do we allow for moisture loss or gain?*
  - This handbook provides "moisture allowances" for some meat and poultry products, flour, **pasta products,** and dry pet food.
  - Test procedures for flour, **pasta products,** some meat, and poultry are based on the concept of a "moisture allowance" also known as a "gray area" or "no decision" area.

E. Requested Interim Action

NPA requests that, while this proposal is under consideration, NCWM issue a letter or formal memorandum to all state weights and measure officials advising them that a 3 percent moisture loss allowance is appropriate for pasta products. Such an action would ensure an end to state and local enforcement that yields flawed findings of a legal violation when moisture loss is not considered. NIST's Weights and Measures Division has stated that it "considers the need for allowances for affected commodities to be pressing and believes that States must make some allowance for these commodities until other data can be obtained for the respective commodities." 21/ Interim guidance would serve the weights and measures regulatory community, the pasta industry, and consumers alike.

* * *

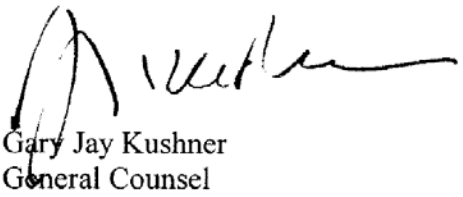
NPA requests that the NCWM establish a moisture loss allowance of 3 percent for pasta products. The historical and most recent data affirm that a 3 percent moisture loss allowance is appropriate and scientifically valid and justified. We look forward to working with the

21/ NCWM Laws and Regulation Committee, 2008 Interim Meeting Agenda, Work Group on Moisture Loss, available at http://www.ncwm.net/pdf/LR-08-Pub15-Final.pdf.

Conference and NIST on this initiative and to reaching an agreeable conclusion for this longstanding topic of concern for the pasta industry.

Please do not hesitate to contact me if you have questions after you have had an opportunity to review the enclosed materials. Thank you for your attention to this proposal. We look forward to working with NCWM on this initiative.

Sincerely,



Gary Jay Kushner
General Counsel
National Pasta Association

Enclosure

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Net Weight Variation in Packaged Pasta[1]

Joel W. Dick
Kantha Shelke
North Dakota State University
Fargo, ND

The U.S. Food and Drug Administration (FDA) in 1980 proposed amendments in the net weight labeling regulations (1) that would quantitatively define permissible variations from stated net weights for several food categories, including foods subject to moisture loss. However, while recognizing that macaroni and noodle products lose moisture during storage, FDA did not propose a moisture-loss tolerance for pasta, because while "macaroni and noodle products have been reported to lose moisture during storage, a reasonable judgment regarding an acceptable level of moisture loss could not be made for one of the following reasons: Adequate data quantifying moisture loss were not provided to FDA, conditions for data acquisition were improper or ill-defined, or reported ranges of observed moisture loss were too broad to support recommendation for a proposed level of moisture loss" (1). FDA further stated that, "providing a sufficiently narrow range of moisture loss for a food under well-defined conditions enables a critical evaluation of the data to be made. This, in turn, enables a tolerance to be proposed that is intended to protect consumer interests while not creating undue hardships for manufacturers and packagers."

Based on the apparent lack of adequate data to defend a specific change in net weight due to changes in moisture content during distribution and storage, the National Pasta Association (NPA) initiated a study to provide data about variations between net weight stated on the package and the actual weight of the pasta.

Basis for Design of Net Weight Study

The design of the study was based on a) the results of an FDA survey of moisture loss in flour packaged in Kraft paper bags (2), b) FDA guidelines for moisture-loss surveys (3), c) guidelines offered to the NPA by FDA officials on March 30, 1981 (4), d) the results of a 1981 NPA Packaging Survey (5), and e) the unpublished results of a private manufacturer's R&D study on pasta net weight.

The results of the private R&D study showed the influence of storage conditions over a 16-week period on net weight variations of different pasta products (shapes and formulations) and package sizes. Controlled storage environments used for the study included desert (90° F, 10% R.H.), ambient (70° F, 50% R.H.), and tropical (80° F, 80% R.H.) conditions. Paperboard containers in 8, 12, and 16 oz sizes were used to package the commercial pasta used in the study. Conclusions from the study were:

a) Pasta packaged and stored in paperboard cartons gains or loses moisture depending on environmental temperature and humidity;
b) The commercial pasta products tested exhibited weight loss of >6% under desert conditions, >1% under ambient conditions, and showed a weight gain of >1% under tropical conditions;
c) Neither product size, shape, composition, nor source of manufacturer showed a significant effect on weight gain or loss.

Published data (6) also indicate that pasta is hygroscopic and eventually reaches an equilibrium with the atmosphere surrounding it. That equilibrium point varies depending on the temperature and relative humidity of the ambient air as well as the initial moisture content of the pasta.

Realizing that not all manufacturers used the same type of containers for packaging retail pasta, the NPA conducted a survey of the pasta industry in 1981 to determine the most commonly used packaging materials and package sizes (5). Responses from companies representing 75% of the domestic pasta production at that time indicated that paperboard cartons made up 42% of the total retail volume, and flexible bags (mostly polyethylene) accounted for the remaining 58%. A report in the literature (7) shows that the loss or gain of moisture in pasta is affected by the water vapor permeability of the material in which it is packaged.

Design of the Study

Commercially produced and packaged pasta was to be examined periodically for net weight under environmental conditions typically encountered in the United States grocery product distribution system. Since previous work showed that pasta weight gain or loss was not affected by product shape or package size, 16 oz samples of spaghetti were chosen to be studied. Spaghetti was packaged in the two most common retail pasta packaging materials—paperboard cartons and flexible polyethylene bags.

Two well-known brands of spaghetti were tested. Brand A was produced and packaged in flexible bags on January 25, 1984 at a midwestern manufacturing location. Brand B was produced and packaged in paperboard cartons on January 28, 1984 by a manufacturer located in the northeastern U.S. Oven moisture content (8) for spaghetti samples taken after exiting from the

[1]Published with the approval of the Director of the Agricultural Experiment Station as Journal Series No. 1709.

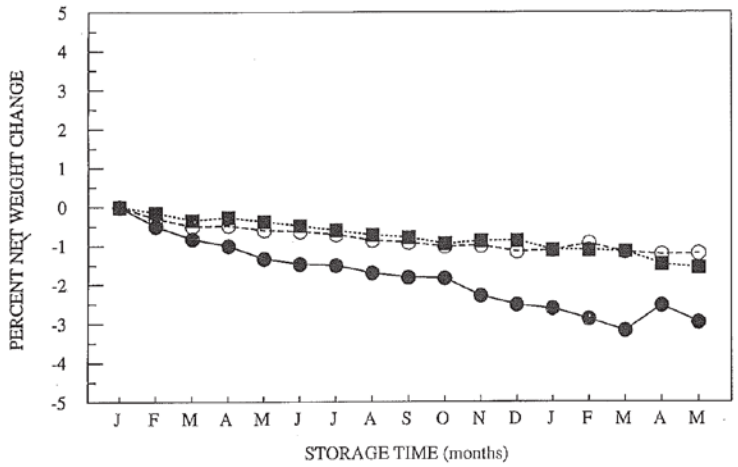

Fig. 1. Net weight change in spaghetti in flexible bags during storage under ambient conditions, in NJ retail store (•), NJ warehouse (o), and MN warehouse (■).

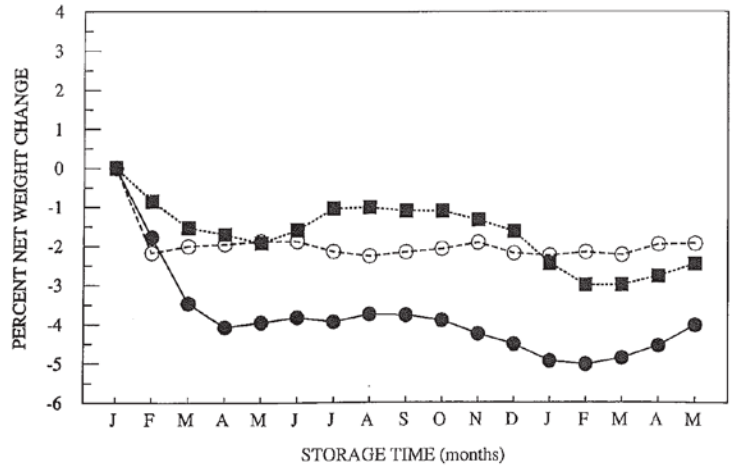

Fig. 2. Net weight change in spaghetti in paperboard cartons during storage under ambient conditions, in NJ retail store (•), NJ warehouse (o), and MN warehouse (■).

Table I. Average Net Weights of Spaghetti from Initial Production to Completion of 15-month Storage in Three Locations

	Brand A (Midwestern U.S. manufacture)			Brand B (Northeastern U.S. manufacture)		
Time Identity	NJ Retail	NJ Warehouse	MN Warehouse	NJ Retail	NJ Warehouse	MN Warehouse
Initial Production:						
Gross weight, g	465.69	465.14	467.28	493.13	494.75	491.32
Tare weight, g	4.31	4.10	4.31	20.40	20.40	20.40
Net weight, g	461.38	461.04	462.97	472.73	474.35	470.92
Initial Storage, g (2 weeks post production)	459.08	459.68	462.30	464.34	464.04	466.90
Final (15 mo.) net weight, g	447.72	455.52	455.76[c]	453.74	465.12	459.32
15 mo. weight loss, g	13.66	5.52	7.21	18.99	9.23	11.60
15 mo. weight loss, %	2.96	1.20	1.56	4.02	1.95	2.46
Maximum weight loss, %	3.18	1.22	1.56	5.02	2.24	2.99
Shown after (mo.)	13	14	15	12	6, 11	12, 13

dryer was 12.4% (Brand A) and 12.5% (Brand B), which met the federal standard of identity specification of 13.0% maximum moisture content for dry pasta.

One randomly selected case of spaghetti each of Brand A (24 package case) and Brand B (20 package case) was shipped from the manufacturers to three typical storage sites: a retail supermarket in metropolitan New Jersey and warehouses in metropolitan New Jersey and Minneapolis, MN. Each case was labeled "Test Sample—Not for Sale" and was accompanied by ten empty 16 oz-size containers to be used for determining tare weight. Storage locations were selected to represent neither environmental extremes of desert nor tropical conditions.

The New Jersey retail store used in this study was a large air-conditioned facility, chosen because it was thought to represent a supermarket situation typical of the storage conditions used to display the bulk of the pasta sold in the U.S. domestic market. The test package (labeled "Not for Sale") of pasta was placed in a location adjacent to the pasta displayed for sale in the store. Because the store was air-conditioned, it was assumed *not* to be a "worst case" situation for net weight variation in a retail storage situation.

Initial storage weights (to the nearest 0.1 g) for individual packages in each of the cases tested were determined on February 11, 1984, and at approximately the same day of the month for the next 15 months. Each periodic measurement included both the actual gross weight of each 16 oz-size package, and the tare weight, the average weight of ten empty 16 oz-size containers. Net weight of each package was the actual gross weight minus the mean tare weight.

Net weight measurements were submitted monthly to the Department of Cereal Science and Food Technology at North Dakota State University for tabulation. The accumulated measurements were analyzed upon completion of the 15-month storage survey to obtain the final data now published.

Results of the Net Weight Study

The results of the study are shown graphically in Figures 1 and 2, and summarized numerically in Tables I and II. Highlights of the study have been presented previously (9).

Table I shows the maximum percentage change in pasta weight over time from the three storage locations and two packaging materials. Pasta stored in all three locations and in both packaging materials showed a net loss in weight when compared to the initial net weight at the time of production. The retail storage location showed a larger percentage change in pasta net weight than either warehouse storage location. Pasta stored

in paperboard cartons showed a larger percentage change in net weight than did pasta stored in flexible bags. Maximum loss in pasta net weight ranged from a low of 1.2% when stored in flexible bags at the New Jersey warehouse location, to a high of 5.0% when stored in paperboard cartons at the New Jersey retail store.

Figures 1 and 2 show graphically the percentage change in pasta net weight when compared with the initial net weight at the time of production. Pasta packaged in paperboard cartons loses weight relatively fast within the first two to three months after production, then fluctuates up and down thereafter with the change in ambient conditions (Fig. 1). Pasta packaged in flexible bags loses weight at a rate which is more gradual and less responsive to change in ambient storage conditions than paperboard cartons (Fig. 2).

Discussion of Results

Since FDA is unlikely to be concerned with testing packages from the warehouse, discussions about this study will be based on the retail storage data.

It is likely that the initial weight loss rate for pasta is dependent on climatic conditions during manufacture as well as on the original pasta moisture. Nonetheless, the pasta would be expected at some time to reach an equilibrium point of minimum net weight, with the higher the initial moisture content of the pasta at the time of manufacture, the greater the maximum weight loss expected. Had the initial moisture content of the pasta studied been 13.0%—the maximum allowed by the federal standard of identity—instead of 12.4% (Brand A) or 12.5% (Brand B), a greater maximum loss in net weight would have been expected than was actually observed. Even under conditions of this study, which were not necessarily conducive to dehydration, pasta lost up to 5% new weight.

Keeping the above comments in mind, the results of this study should represent a retail storage situation not atypical for dry pasta in the U.S., although typical shelf storage time is difficult to predict because of differences in shelf stocking methods. Based on the result of this study and on additional supporting information not presented here, it would seem appropriate for FDA to consider establishing a net weight tolerance for pasta manufacturers of 5.0% of the labeled weight for pasta packaged in paperboard cartons and 3.2% of the labeled weight for pasta packaged in flexible bags. Thus, for a 16 oz (1 lb) paperboard package of pasta, a minimum net weight of 15.2 oz at the point of purchase should be allowed, and for a 16 oz (1 lb) flexible bag package of pasta, a minimum net weight of about 15.5 oz (15.49 oz) should be allowed. Institution of these net weight tolerance limits would seem to afford the pasta manufacturers the benefit of the doubt in being found "under weight" in a retail situation in which they have little or no control of ambient conditions, and at the same time assure consumers that they are not purposely being shorted by the manufacturer.

Table II. Summary of 15-Month Pasta Net Weight Study

Package and Location	Net Weight Maximum g (oz)	Net Weight Minimum g(oz)	Loss %
Flexible bags			
NJ - Retail	461.38 (16.27)	446.71 (15.76)	3.2
NJ - Warehouse	461.04 (16.26)	455.42 (16.06)	1.2
MN - Warehouse	462.97 (16.33)	455.76 (16.07)	1.6
Paperboard cartons			
NJ - Retail	472.73 (16.68)	448.98 (15.84)	5.0
NJ - Warehouse	474.35 (16.73)	463.73 (16.36)	2.2
MN - Warehouse	470.92 (16.61)	456.84 (16.11)	3.0

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