

The tendency of referencing to AOAC methods in TCVNs, QCVNs and harmonizing TCVNs in the food chain according to the AOAC methods

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Abstract

At the end of 2022, Vietnam's standard system (TCVN) had 2026 national standards related to the food chain (food and feed), of which the number of test method standards accounts for nearly 70 %. The test method standards have played an extremely important role in the food chain. The harmonization of TCVN on test methods for the food chain according to international standards (ISO standards) is always a priority in the process of developing and perfecting the TCVN system. Moreover, there are also many TCVNs built on the basis of harmonizing (or referencing) methods of the International Association of Official Analytical Collaboration (AOAC International). This article analyzed a number of cases in which the AOAC method is referenced in the national standards and national technical regulations of Vietnam; the harmonization of national standards according to the AOAC method and the use of the AOAC method in a number of public and non-public laboratories. From the above analysis results, it is possible to comment on the trend of using AOAC methods in testing activities in Vietnam.

Keywords: *Testing, test method standards, AOAC methods, food chain, overview.*

1. INTRODUCTION

Generally, in the field of testing and food testing in particular, testing methods are increasingly diversified, and standardization organizations are also actively developing test method standards. In Vietnam, since the transformation of the development of Vietnamese standards (since 2007 called "national standards", abbreviated as TCVN) according to the model of the International Organization for Standardization (ISO) in the early 90s of the 20th century, the TCVN system of test methods was mainly harmonized with ISO standards. According to the statistics of 2022 [1], there are 7519 TCVNs out of 12618 current TCVNs in harmony with international standards, regional standards, and advanced foreign standards, the harmonization rate reaches 59.6%; in which there are 5570 current TCVNs in harmony with ISO standards (mostly test method standards), accounting for 44.1% of the total number of TCVNs and 74.1% of the harmonized TCVNs. However, in some specific sectors, such

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as the food industry, in addition to ISO standards, standards of other organizations, such as the International Association of Official Analytical Collaboration (AOAC International), are also an important basis for consulting and compiling the draft TCVN.

AOAC is an American-based non-profit organization dedicated to researching and accreditation food, nutrient, and environmental analytical methods. AOAC was established to promote the development and sharing of accurate, highly reliable, and widely accepted analytical methods worldwide. The organization has an important vision and role in testing, particularly in areas such as food, beverage, and botanicals. For the food and beverage industry, AOAC plays an important role in developing test method standards. These standards are used to ensure product quality and ensure food safety for consumers.

This review article analyzed the use of AOAC's test method in TCVN and QCVN (national technical regulations) in two aspects: reference and harmonization.

2. REFERENCE AOAC METHODS IN STANDARDS, TECHNICAL REGULATIONS

As a rule, in the standards of technical requirements for products, for each criterion given, there must be a test method attached [2, 3]. For the TCVN system, at the same time with the increase in the harmonization ratio of national standards with international standards and regional standards, the reference to international and regional standards in the TCVN has gradually been replaced by referring to the TCVN test methods in the TCVN on technical requirements. For example, TCVN 7047:2002 on frozen meat [4] refers to 01 ISO test method for detecting chloramphenicol antibiotic residues and 04 AOAC test methods for determination of heavy metals (cadmium), growth hormone (diethylstilbestrol), antibiotic residues (tetracycline) and microorganisms (*Clostridium botulinum*). In the version of TCVN 7047:2009 [5], residues of veterinary drugs (including antibiotics) according to current regulations, microbiological criteria are not regulated for *Cl. botulinum* and cadmium indicators already have a test method according to TCVN, so TCVN 7047:2009 only refers the AOAC test method for diethylstilbestrol. The current version (TCVN 7047:2020 [6]) does not regulate growth hormones, so no AOAC test method is referenced. As another example, TCVN 6175:1996 [7] on ready-to-eat seasoned dried squid and fish products refers to the AOAC test method for the determination of sorbic acid, which is a food additive. The current version (TCVN 6175-1:2017 [8]) does not specify sorbic acid or refer to the above AOAC test method. On the other hand, adds the AOAC test method for the determination of methylmercury.

For the national technical regulations in the field of food promulgated by the Ministry of Health and the Ministry of Agriculture and Rural Development. In the QCVN group for the limit of contaminants in food: all 15 test methods referenced to apply to 6 groups of mycotoxins specified in QCVN 8-1:2011/BYT [9] are all AOAC test methods. Meanwhile, QCVN 8-2:2011/BYT [10] on the limit of heavy metal pollution: citing 13 test methods according to TCVN (including 3 TCVN equivalent to AOAC) and 5 AOAC methods; QCVN

8-3:2012/BYT [11] on microbial contamination: 14 test methods referenced are TCVN (equivalent to ISO), 2 referenced test methods are ISO and no AOAC method. Both ISO and AOAC International have published many test method standards for contaminant limits in food, but the above information shows the inconsistency of the QCVN development committees regarding the point of view on referencing test methods. For the QCVN group on beverage products also issued by the Ministry of Health: QCVN on alcoholic beverages [12] referenced the AOAC method with a high rate (11/28), QCVN on natural mineral water and bottled water [13] refers the AOAC method with a lower rate (8/41), while the QCVN on non-alcoholic beverages [14] only refers one AOAC method (1/20). However, in this case, it is also important to note that ISO does not currently have a standard for alcoholic beverages.

The QCVN issued by the Ministry of Agriculture and Rural Development for the food chain is mainly a technical regulation on the process. The number of QCVNs on safety limits for food products is very limited and almost non-referential to the AOAC method. Only QCVN on raw milk [15] referenced the 01 AOAC method. For animal feed, in QCVN on the maximum allowable limit of pollutants in mixed feed for cattle and poultry [16], there are 3/16 standards referenced as the AOAC method.

Not only referenced in the documents such as TCVN, QCVN, and AOAC methods are also used in Vietnamese laboratories. For example, in the food testing laboratory of the Quality Assurance and Testing center 3 (Quatest 3), among the accredited tests in the VILAS system [17], many AOAC methods are used, such as the determination of moisture content of cereals, fruits; the determination of protein content of meat, lactose content of dairy products etc. There are 77 out of 369 testing parameters using the AOAC methods, possibly the only specific method for the matrix or used in tandem with the method according to TCVN and/or ISO, can use AOAC directly or refer to AOAC as the in-house method. At UPSCIENCE Vietnam Food and Feed Analytical Laboratory in Binh Duong Province, 2/26 microbiological parameters and 18/112 chemical parameters using AOAC methods were applied among accredited test methods according to VILAS [18]. Even the laboratories of food processing enterprises such as Vietnam Animal Industry Joint Stock Company (VISSAN) use a number of AOAC methods for the qualitative and quantitative identification of bacteria such as *E. coli* and Coliform in meat products [19].

Thus, with the development of ISO test method standards and the compilation of several TCVN test method standards based on the AOAC methods, the reference to the AOAC methods in TCVN's food standards tends to decrease. Meanwhile, the reference to the AOAC method in the QCVNs has not been consistent. In laboratories, preliminary information indicates that the use of the AOAC methods is quite common, depending on the specific test, the matrix involved and the laboratory conditions.

3. HARMONIZATION OF NATIONAL STANDARDS (TCVN) BY AOAC METHODS

The wide variety of food products around the world has led to the development of many different analytical methods issued by different standardization organizations [20]. As a result, there is a need to harmonize test methods in order to facilitate the use of the test method in laboratories as well as the use of test results for regulatory agencies and consumers.

According to preliminary statistics, at the end of 2022, Vietnam's national standards (TCVN) system had 2026 standards related to the food chain (food and feed). In which the number of test method standards accounts for about 69.7% (Figure 1).

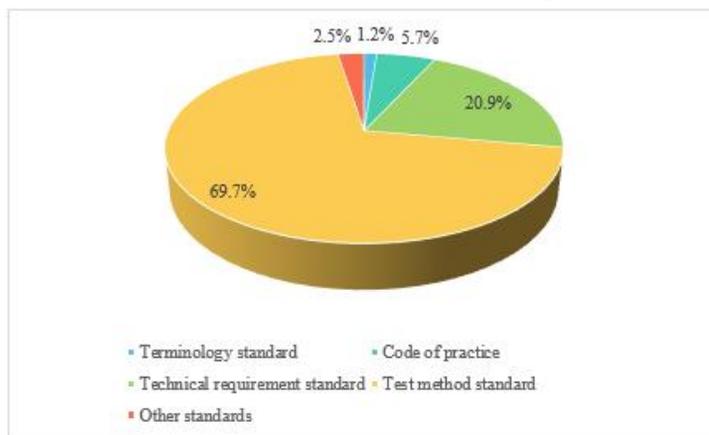


Figure 1. Structure of the national standard system (TCVN) for the food chain in 2022

The number of TCVNs in harmony with AOAC methods is 239 standards, accounting for 16.9% of test method standards for the food chain (compared to 46.2% of TCVNs equivalent to ISO standards and 12.0% of TCVNs equivalent to European standards - EN) (Figure 2). These parameters contribute to the harmonization rate of the group of test method standards for the food chain reaching 85.3%, higher than the harmonization rate of 59.6% of the TCVN system in 2022.

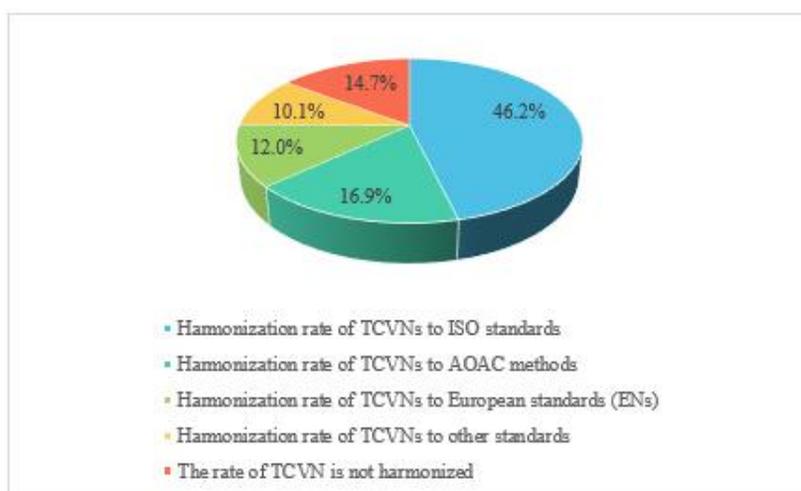


Figure 2. TCVN harmonization rate on test methods for food chain in 2022

The TCVN groups that harmonize AOAC methods include:

* Microbiology in the food chain: ISO Technical Subcommittee ISO/TC 34/SC 9 currently has up to 94 test method standards on microorganisms in food, most of which have been adopted and became TCVN. This group of ISO standards is quite diverse, but there are still some specific criteria that do not have ISO methods. These standards have been developed by Vietnam Technical Committee TCVN/TC/F13 *Analytical and Sampling Methods* on the basis of AOAC methods.

Example 1: *Staphylococcus aureus* is one of the bacteria that cause foodborne illness. However, the ISO method [21] targets coagulase-positive microorganisms, which are mainly *Staphylococcus aureus* but may also include other *Staphylococcus* species. Therefore, TCVN 7927:2008 Foodstuffs - Detection and enumeration of *Staphylococcus aureus* by most probable number (MPN) method was developed on the basis of reference to AOAC 987.09. Besides, a number of TCVNs are also developed on the basis of AOAC reference to detect the toxin of *Staphylococcus aureus*, such as TCVN 9582:2013 Foodstuffs - Method for detection of Staphylococcal enterotoxin (refer to AOAC 976.31) and TCVN 11068:2016 Foodstuffs -Detection of staphylococcal enterotoxins by polyvalent enzyme (refer to AOAC 993.06).

Example 2: The TCVN 7924 (ISO 16649) series [22-23] is applied to the enumeration of *Escherichia coli* that are positive for the enzyme β -glucuronidase, so some pathogenic strains of *E. coli* negative for β -glucuronidase may not be identified. For the detection of these strains of *E. coli*, besides a number of TCVN adopted ISO standards [24-25], there are TCVN 11397:2016 *Microbiology in food - Detection of E. coli O157:H7 - 8 - hours method* reference to AOAC 2000.13 method.

Along with the methods applicable to the above specific criteria, some of the AOAC harmonized standards are rapid test methods, using ready-made media, which shorten the time and reduce the testing operation compared with standard methods, meeting the increasing testing demand, especially for product announcement as prescribed in Decree No. 15/2018/ND-CP of the Government [26].

* Physical and chemical analysis methods for foods in general: to complement the TCVNs adopted ISO standards, some TCVNs refer to the AOAC method (which can be said to be technically equivalent). For example, TCVN 12348:2018 *Acidified foods - Determination of pH* (refer to AOAC 981.12), TCVN 8126:2009 *Foods - Determination of lead, cadmium, zinc, copper, and iron - Atomic absorption spectrophotometry after microwave digestion* (refer to AOAC 999.10). In addition to heavy metals and mycotoxins, there are standards for specific criteria such as cholesterol (TCVN 12385:2018 *Foodstuffs - Determination of cholesterol - Gas chromatographic method* reference to AOAC 994.10) or active ingredients in health supplement food.

* Chemical analysis methods for some specific food products such as dairy products, meat, aquatic products, beverages, animal feed, etc. Example: TCVN 8767:2011 *Meat and*

meat products - Determination of moisture and fat content - Microwave and nuclear magnetic resonance analysis refer to AOAC 2008.06.

Normally, in the process of developing a TCVN with reference to AOAC, it will be necessary to edit it to meet the rules for the structure and drafting of the TCVN according to the provisions of TCVN 1-2:2008 [2]. In particular, many of the previously published AOAC methods do not have sections for reagents, instruments, or listings that are incomplete. Meanwhile, the structure and drafting of the content of the standard documents TCVN [2], as well as ISO [3], must ensure logic. Comparing the content of some TCVNs with the content of AOAC methods, it can be seen that many AOAC methods do not ensure the above principles. For example, in AOAC method 998.12 *C-4 Plant Sugars in Honey Internal Standard Stable Carbon Isotope Ratio*, the content does not refer to the concept of “internal standard” as in the method name; many headings of articles are not numbered; in the text there are many paragraphs that are not clear whether they belong to the major or minor clauses in the large section (the 6th paragraph of section C is not clear whether it belongs to section C(2)); the results calculation instructions are not placed in a separate section, but are included in the description of the analytical procedure, etc. The recently published AOAC methods have used a new format [27], detailed and more consistent with the layout of test method standards as specified by ISO and TCVN. However, when developing the TCVN, it still needs to be edited to ensure compliance with the principles and regulations on the structure and drafting of the TCVN.

In addition to the TCVNs directly referring to the AOAC, there are a number of TCVNs that adopt ISO standards or European standards (ENs) and thereby indirectly harmonize with the AOAC method. Example: TCVN 9514:2017 (ISO 20634:2015) *Infant formula and adult nutritionals - Determination of vitamin B12 by reversed phase high performance liquid chromatography (RP-HPLC)* fully equivalent to ISO 20634:2015, while this standard is equivalent to AOAC 2011.10. It should also be emphasized that AOAC is currently collaborating with ISO in the development of a number of joint test methods, for example, test methods for dairy products, and nutritional formula products [28]. Another case is TCVN 7731:2008 (EN 14573:2004) *Food products - Determination of 3-monoclopropan-1,2-diol by gas chromatography/mass spectrometry (GC/MS)* which is completely equivalent to EN 14573:2004 but this European Standard has the same methodological principles and the same interlaboratory test data as AOAC 2000.01, so it can be considered that TCVN 7731:2008 (EN 14573:2004) is harmonized with this AOAC method.

4. CONCLUSION

Although there is no consistency in terms of test methods referenced in QCVNs, AOAC methods still play a certain role in testing activities, both in terms of state management (referenced in QCVNs) and actual demand in laboratories in Vietnam. For the

relevant TCVN system, the reference to the AOAC method is somewhat limited due to the specificity of the criteria specified in the TCVNs and because more and more AOAC methods already have equivalent TCVNs. The harmonization rate of test method standards for the food chain has reached 85%, of which nearly 17% is the harmonization rate of TCVN with the AOAC method (the rate is the second largest rate, only behind the harmonization rate of TCVN with ISO standard). It has contributed to international trade activities as required by the TBT Agreement on technical barriers to trade as well as free trade agreements (FTAs) that Vietnam has signed. In Vietnam, the AOAC methods and the TCVN on food testing methods, in general, are performing well in supporting food production and processing establishments and state authorities and contributing to ensuring the quality and safety of food products.

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Xu hướng viện dẫn phương pháp AOAC trong TCVN, QCVN và hài hòa TCVN đối với chuỗi thực phẩm theo phương pháp AOAC

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Tóm tắt

Tính đến cuối năm 2022, hệ thống tiêu chuẩn quốc gia của Việt Nam (TCVN) có 2026 tiêu chuẩn liên quan đến chuỗi thực phẩm (thực phẩm và thức ăn chăn nuôi), trong đó, số lượng tiêu chuẩn phương pháp thử chiếm gần 70 %. Có thể thấy rằng, phương pháp thử đóng vai trò vô cùng quan trọng đối với chuỗi thực phẩm. Việc hài hòa TCVN về phương pháp thử nghiệm đối với chuỗi thực phẩm theo tiêu chuẩn quốc tế (tiêu chuẩn ISO) luôn là ưu tiên trong quá trình xây dựng và hoàn thiện hệ thống TCVN. Tuy nhiên, bên cạnh đó cũng có nhiều TCVN được xây dựng trên cơ sở hài hòa (tham khảo) phương pháp của Hiệp hội quốc tế về hợp tác phân tích (AOAC International). Bài báo này phân tích một số tình huống viện dẫn phương pháp AOAC trong các tiêu chuẩn quốc gia, quy chuẩn kỹ thuật quốc gia của Việt Nam; việc hài hòa tiêu chuẩn quốc gia theo phương pháp AOAC và việc sử dụng phương pháp AOAC tại một số phòng thử nghiệm công lập và ngoài công lập. Từ kết quả phân tích nêu trên, có thể đưa ra nhận định về xu hướng sử dụng phương pháp AOAC trong hoạt động thử nghiệm tại Việt Nam.

Từ khóa: *Thử nghiệm, tiêu chuẩn phương pháp thử, phương pháp AOAC, chuỗi thực phẩm, tổng quan.*