codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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Agenda Item 18 **CX/FAC 05/37/37**
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JOINT FAO/WHO FOOD STANDARDS PROGRAMME
CODEX COMMITTEE ON FOOD ADDITIVES AND CONTAMINANTS
Thirty-seventh Session
The Hague, the Netherlands, 25 – 29 April 2005

PRIORITY LIST OF FOOD ADDITIVES, CONTAMINANTS AND NATURALLY OCCURRING TOXICANTS PROPOSED FOR EVALUATION BY JECFA

• COMMENTS (CL 2004/9-FAC)

The following comments have been received from: Japan and ISA

JAPAN

Background

1. In Japan, instant noodles have been regulated by the standards in the Food Sanitation Law; Acid value (AV) of fats and oils contained in instant noodles shall not be more than 3 and peroxide value (PV) shall not be more than 30. This standard was established after we experienced food-poisoning incidents (69 patients) in 1964 caused by the degradation of oil in the instant noodle.
2. The 27th Session of the Codex Alimentarius Commission noted that the Committee on Food Additives and Contaminants (CCFAC) considered that the PV for instant noodles was not a question of safety and therefore was not included in the priority list for JECFA evaluation. The CCFAC noted that there were no data proving a positive correlation between peroxide values of foods and food toxicological parameters. The Commission noted that the draft Standard for Instant Noodles, adopted at Step 5 by its 26th Session, had been circulated for comments at Step 6. A revised text was under preparation to take account of the comments received; the revised draft Standard would be circulated for additional comments and consideration for advancement to Step 8 by the Committee on Cereals, Pulses and Legumes while the list of food additives was to be completed and endorsed by CCFAC.
3. The Delegation of Japan expressed its concern that the CCFAC reply was not based on a risk assessment and reiterated its proposal to include PV in the draft Standard for Instant Noodles.
4. The Commission agreed that the elaboration of the draft Standard should proceed without further delay, with the understanding that the inclusion of PV could be decided by CCFAC in the future in the light of relevant data to be submitted by the Government of Japan to the CCFAC for consideration.

Comments

1. Japan believes that the provisions on PV should be established to protect not only the quality but also the consumers' health, because only the provision of Acid Value is not enough to catch the rancidity of oils and fats. PV holds the amount of peroxide caused by absorption of atmospheric oxygen in fats and shows the producing amount of peroxide as a toxic substance.

2. Japan has been performing the study on the degree of PV and toxicity of fats with degradation in Instant Noodles, and also the study on actual condition of PV in Instant Noodles being distributed in the international markets. Japan herewith submits the results of these studies.
3. According to the results of these studies, it is concluded that oxidation of the oil is very apprehensive phenomenon for food safety because it involves formation of lipid hydroperoxide (indicated by PV) and the secondary oil oxidized product. This change can be measured only by PV, not by AV, because PV and AV do not increase simultaneously. Consequently, measuring PV in oil is very important to grasp the deterioration level of the oil in food from the food safety point of view. The formation of lipid hydroperoxide is slow at first; however, it increases at an explosive pace after the induction period. To prevent this explosive increase of lipid hydroperoxide, keeping the PV at low level, such as 30 meq/kg, is a significant point.
4. Japan strongly proposes that the provision of PV should be considered in the CCFAC based on the evaluation by JECFA (Information on PV to be evaluated by JECFA is attached below).

INFORMATION ON THE CONTAMINANT TO BE EVALUATED BY JECFA

1. Proposal for inclusion submitted by:

   Japan

2. Name of compound; chemical name(s):

   Peroxide Value

3. Identification of (additional) data (toxicology, metabolism) which could be provided to JECFA:

   - Studies on Degradation of Fats in Foods Regarding Relationship between the Degree of Degradation and the Toxicity of Fats in Pre-Cooked Instant Noodles (See Annex 1)
   - List of articles available (See Annex 2)*

4. List of contact persons, including name and address, providing surveillance data with quality assurance information, preferably from three or more regions of the world:

   Codex Contact Point for Japan

* The hard copies of the articles listed in the Annex 2 will be submitted by separate mail.

Studies on Degradation of Fats in Foods Regarding Relationship between the Degree of Degradation and the Toxicity of Fats in Pre-Cooked Instant Noodles

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Introduction

Instant Noodle (instant ramen) was invented in Japan about a half century ago and is now eaten 65.2 billion packages per year (2003 data) by a lot of people all over the world[1)]. This food is easy to cook and just boiling it in a hot water for a few minutes (Packaged Noodle) or just pouring a hot water to the noodle (Cup-type Noodle) because the starch of the noodle is pregelatinized. Gelatinization is important process to cook noodle, for instance, the pasta before cook is very hard because the starch in the pasta is not gelatinized. Therefore, the pasta must be boiled to make it soft. This process is “gelatinization” and the way of frying a boiled noodle with oil was hired to fix the pregelatinization condition for instant noodles[1)]. Consequently, it would be easily understood that frying the boiled noodle is very important process to prepare Instant Noodle and oil is indispensable ingredient for Instant Noodle.

About 40 years ago, 1964-1965, Japan had terrible food-poisoning incidents caused by the degradation of oil in Instant Noodle[2]. Fortunately, no one died in these incidents, however, many people who ate degraded Instant Noodle had nausea, vomiting, diarrhea, abdominal pain, feeling of weariness and headache. In the severest case, 69 people (men: 38, women: 31) who ate Instant Noodle manufactured by the same company suffered from food-poisoning. The degradation levels of the oil in the noodles were peroxide value (PV): 565-805 meq/kg and acid value (AV): 7.1-28.8. After that, the Ministry of Health and Welfare, current the Ministry of Health, Labor and Welfare, in Japan set standard value for fried type Instant Noodle in Food Sanitation Law to protect the food-poisoning and control the quality of Instant Noodle[3]. In the law, the standard value for PV was set in 30 meq/kg or less than that and AV was set in 3 or less than that. After setting these values, no food-poisoning incidents caused by Instant Noodle have happened so far in Japan.

Japan has proposed the food standard for Instant Noodle to the Codex Committee on Cereals, Pulses and Legumes through the Codex Regional Coordinating Committee for Asia to make it international standard. However, including standard value on PV is still under discussion because many countries believe that measuring only AV is enough to grasp the degradation situation of oil in Instant Noodle. Taking account of food poisoning incident in Japan, measuring PV would be very important from the food sanitation point of view. Consequently, in this review, the relationship between PV and AV in Instant Noodle, how increase PV in Instant Noodle and the relationship between oxidation of the oil and toxicity were discussed.

<u>Relationship between PV and AV in Instant Noodle</u>

The concept for measuring PV and AV are completely different. It is now accepted that the secondary oil oxidized products such as polymerized oil, cyclic fatty acid, hydroperoxy alkenal and hydroxyl alkenal are main cause of toxicity in oxidized oil[4)-14)]. Therefore, the formation of lipid hydroperoxide, the primary oil oxidized product, must be suppressed to prevent the formation of the secondary oil oxidized products in Instant Noodle. In Japan, PV is hired to monitor the formation of the primary oil oxidized product, namely lipid hydroperoxide[15)-17)]. On the contrary, AV is measured to keep the food quality. During the food processing and storage, free fatty acids are formed in the noodle by the hydrolysis of the oil. Free fatty acid itself is not a very toxic compound, however, it becomes a cause of the reduction of flavor and taste. The purpose of measuring AV is to check the free fatty acid level in Instant Noodle[18)19)].

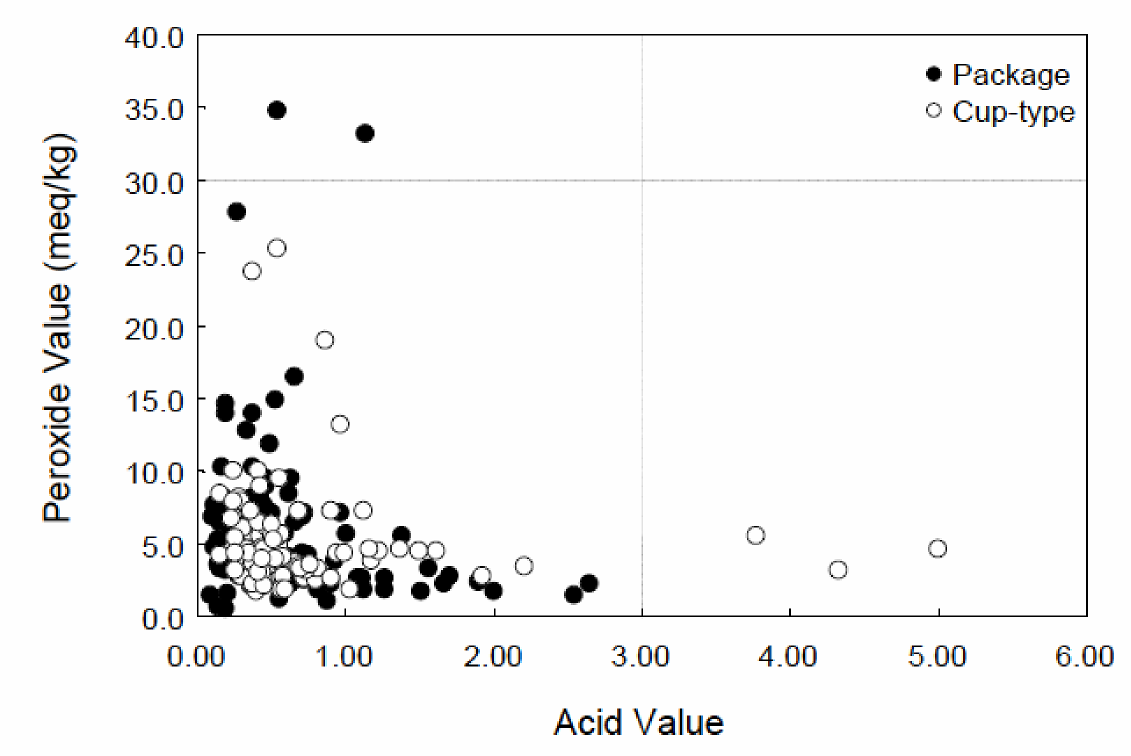

Figure 1. Acid value (AV) vs peroxide value (PV) in 218 Instant Noodles collected from all over the world[20].

Japan proposed the food standard of Instant Noodle that contains PV and AV to the Codex Regional Coordinating Committee for Asia to make it international standard. However, several representatives of Asian countries did not accept the proposal from Japan. Particularly, including PV in the standard was opposed because they recognized that the PV and AV would increase together during the deterioration of Instant Noodle and measuring AV is enough to keep the food safety and quality. As mentioned above, the concepts for measuring PV and AV are completely different and PV is an essential item to keep the food safety. Consequently, 218 kinds of fried type Instant Noodles were collected from commercial base of all over the world and measured PV and AV of them to grasp the deteriorated situation of Instant Noodles sold in the market[20]. Furthermore, the relationship between PV and AV values was investigated to confirm the truth of other countries opinions. All the measured values on PV and AV are plotted in Figure 1. These results show that the both values are spread to wide range and some of them exceed the criteria (PV: 30 meq/kg and AV: 3) established in Food Sanitation Law in Japan. Since almost all samples were sold in cool condition, the samples exceeding 30 in PV might be exhibited under strong light for a long period. On the other hand, the samples exceeding 3 in AV might be stored under high humidity. Light and moisture strongly affect the degradation of oils. Miura et al.[11][12] made a deteriorated Instant Noodle, which is as same as deteriorated Instant Noodle caused food poisoning in 1964, with sunlight and high temperature and succeeded in reappearing the food poisoning with the sample. Consequently, it would be said that cutting light or sun light is the most important way to preserve Instant Noodle even the material of the package film can suppress the UV and water transmission. In Figure 1, if the both PV and AV increase simultaneously during storage, the approximating curve against these plots must become ever-increasing curve. However, the plots are not scattered like that. The coefficient of correlation for PV and AV was calculated with Pearson's product-moment coefficient of correlation and the result was -0.1083. This value means that the plots are scattered in the downward-sloping and the correlation between PV and AV is poor because the coefficient of correlation is lower than zero and the absolute value is near zero. Consequently, the coefficient of correlation reveals that PV and AV do not form simultaneously in the oil of Instant Noodle during the deterioration. Furthermore, the P value was also calculated and the value was 0.1106. This value also explains that the relation between PV and AV is not significant because the value was bigger than 0.05. Therefore, analyzing only AV cannot grasp any deteriorated situation of the oil in Instant Noodle and analyzing both PV and AV has a strong and significant meaning. We conclude that PV is also an indispensable factor to keep the food safety and quality of Instant Noodle.

How increase PV in the oil of Instant Noodle

A great number of studies concerning the oxidation or heating of the oil have been carried out so far. These studies are mainly separated to three types of studies.

(1) The most popular study is that the oil is heated at more than 250 ^{o}C under oxygen omitted circumstances such as under nitrogen, carbon dioxide, etc[4)-6)]. This kind of heating forms polymerized oil and cyclic fatty acid without containing oxygen molecular in the structure. These compounds are very toxic, however, these compounds are not oxidized compound. Furthermore, it must be said that these study conditions are not realistic. Consequently, these results are not available when the food toxicity of the oil is discussed.

(2) The oxidations of the oil under atmospheric condition are also carried out[7)-10)]. In this degradation, the oxidation of the oil proceeds by radical chain reaction via lipid peroxyl radical (Figure 2)[21)]. Therefore, the compound formed in this reaction contains oxygen molecular in it. These studies are separated to two types of studies. One is heating the oil over 100 ^{o}C and the other is less than that. Taking account of the accumulation of lipid hydroperoxide (PV) in the system, the heating temperature is important point. For instance, the temperature usually hired for deep-fry and stir-fry is around 180 ^{o}C and the lipid hydroperoxide is decomposed easily under this condition[22)]. As the result, the PV of the oil does not increase it and the secondary oil oxidized products are formed instead of that. However, it has been reported that the polymerized oil and cyclic fatty acid are not accumulated much in the system. Frankel et al. measured the cyclic fatty acid level in the oil used at fast foods restaurant and found that 0.1-0.5% of total fatty acid was changed to cyclic fatty acid[23)]. The oxidation heated at less than 100 ^{o}C accumulates lipid hydroperoxide in the system because the rate of the formation of lipid hydroperoxide is faster than the rate of the decomposition of that. Normally, this kind of oxidation is called "autoxidation". The autoxidation also proceeds under atmospheric condition and accumulates the lipid hydroperoxide (PV) in the system at first (Figure 3)[24)]. The amount of the lipid hydroperoxide finally reaches to the top, after that, it starts to decrement because the rate of the formation of lipid hydroperoxide becomes slower than the rate of the decomposition of that. The reaching level depends on the kinds of fatty acids consisting of the oil, heating temperature, etc. The decomposed lipid hydroperoxide forms aldehyde, ketone, alcohol, alkane, etc. It is now accepted that the hydroxyl alkenal and hydroperoxyl alkenal formed in autoxidation is very strong toxic compounds[14)]. Therefore, the autoxidized oils are also toxic.

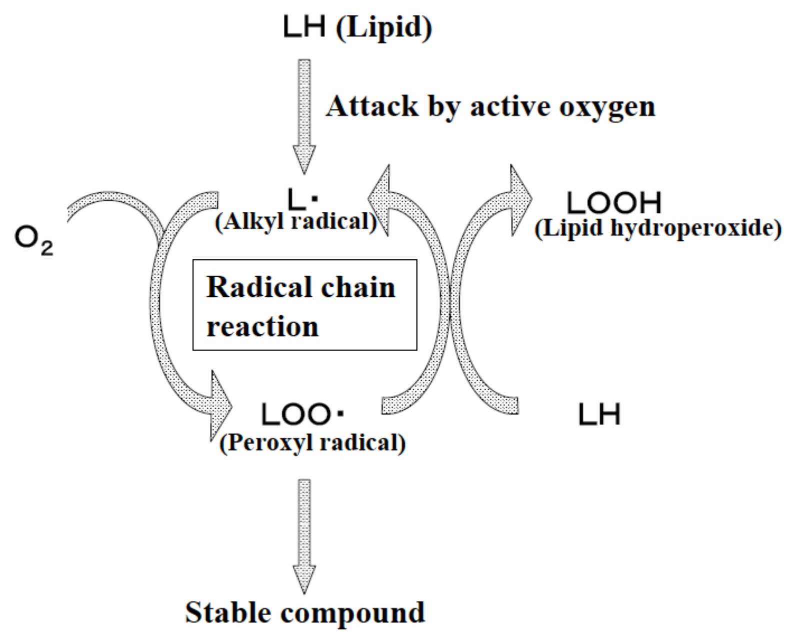

Figure 2. Radical chain reaction on lipid oxidation.

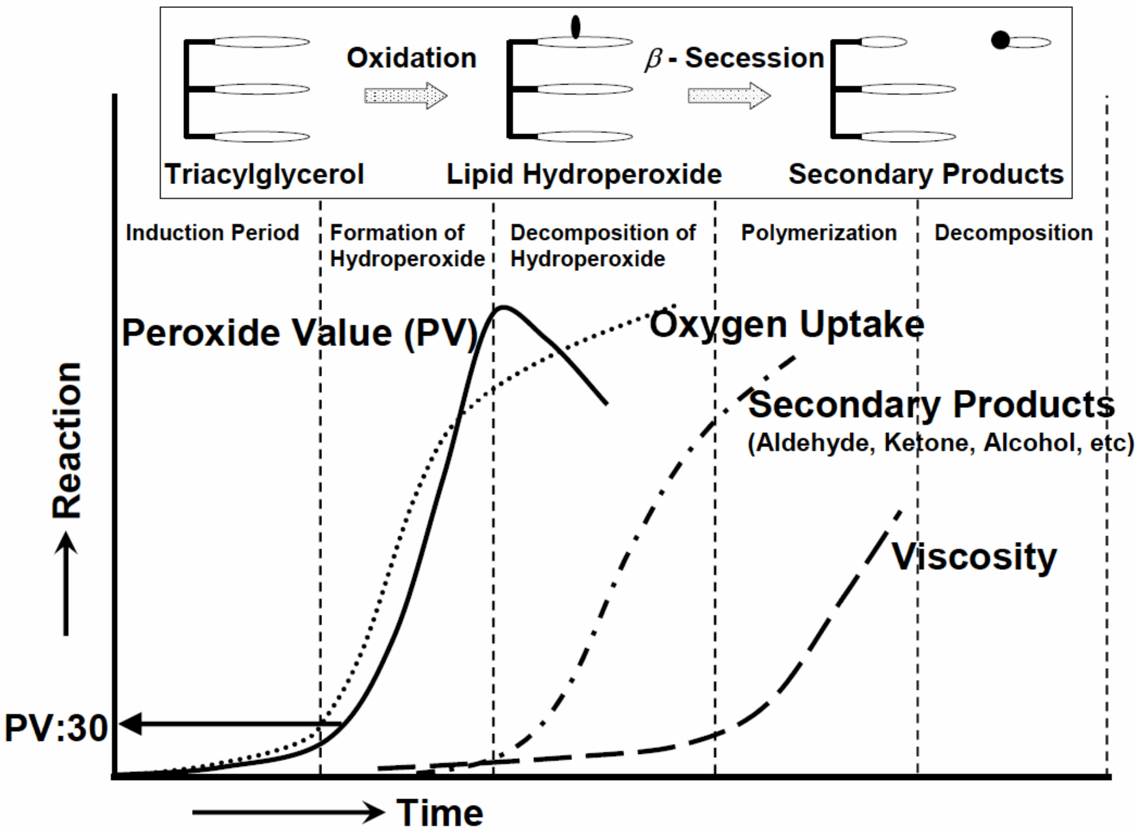

Figure 3. Each stage of autoxidation of the lipids.

(3) The oil degraded by heat and light is also a big problem. This degradation is mixture of autoxidation and photoxidation[11)-13)]. Photoxidation is not radical reaction, but ene reaction[25)]. Therefore, the reaction mechanism is different from radical chain reaction to form the different kinds of degraded oil compounds. The oxidation of the oil in Instant Noodle that caused the food toxicity was developed by these reactions as already mentioned in previous section. It is very difficult to understand how the individual reaction intertwine with each other and finally cause the toxic compounds in this oxidation.

Almost all of the oxidation reactions proceed via formation of lipid hydroperoxides. Therefore, to prevent the formation of lipid hydroperoxides is the best way to keep the food safety and quality. The oil in Noodle is also no exception. In fact there are a few studies which measured how increased PV during the degradation of the oil. Therefore, oxidation of the Instant Noodle was carried out to grasp how increase PV in Instant Noodle. As the results, PV increases slowly till the PV reaches to 50 meq/kg, however, after beyond the 50 meq/kg[26)], explosive increment of PV started in the case of the Instant Noodle is Stored at 60 ^{o}C. In Food Sanitation Law of Japan, PV is set in 30 meq/kg or less than that. This would not be a high value. The toxicity of lipid hydroperoxide was investigated by Tovar et al. and the LD_{50} was 12,760 mg/kg mice. On the contrary, LD_{50} of 4-hydroperoxy-2-nonenal, strong toxic compound formed in oil deterioration, is 77.5 mg/kg mice[14)]. Though the deteriorated oil in Instant Noodle which PV is 30 meq/kg does not show any toxicity, the concept of the setting PV in 30 meq/kg is to prevent the oxidation to proceed to the next stage reaction via lipid hydroperoxide and the formation of toxic compounds. Therefore, setting PV in a low value possesses great significance to obtain the quality and safety. Particularly, the low standard value has a great meaning in the case of the oxidation pathway is complicated like the mixture of autoxidation and photoxidation.

The relationship between oxidation of the oil and toxicity

As mentioned above, the lipid hydroperoxides (indicated by PV) are not strong toxic compounds, however, many kinds of studies reveal that the toxicity of the degraded oil increases according to the increase of the lipid hydroperoxide level[10)]. Of course, the toxicity of the oil furthermore increases after decomposition of lipid hydroperoxide starts. In a word, both of lipid hydroperoxide and the secondary oil oxidized products are important toxic compounds[14)].

The toxicity of the degraded oil is normally evaluated by the weight loss, the survival rate, autopsy report, etc. However, the main symptoms of the food-poisoning incident caused by eating of degraded Instant Noodle were nausea and vomiting[2)]. In fact, there is few study with animal which evaluate the nausea and vomiting after administrated oxidized oil because no animal can vomit with the exception of monkey and ferret. To recognize the food-poisoning incidents happened in 1964-1965, to develop a new method which can analyze the nausea and vomiting with animal is indispensable. It has been known that pica[27)-34)], a behavior characterized by eating a nonfood material such as kaolin, is related to the emesis. Animal that was administrated harmful compound is eager to eat non-nutritional kaolin to relieve malaise and the amount of kaolin consumption increases with the degree of the toxicity. Also, it has been recognized that the amount of consumption is related to the degree of gastrointestinal malaise, namely nausea and vomiting. This method might be able to utilize to understand the feeling of animal after fed oxidized oils. Therefore, several degree of oxidized oils extracted from degraded Instant Noodle were administrated to mice and pica was observed (Figure 4)[35)]. All the mice administrated these oils were survived in 28 days sub-acute toxic study (data not shown), however, the amount of kaolin intake increased according to the degree of oil degradation. These results indicate that not severely oxidized oil also indicate harmful symptom in mice. In a previous paper[10)], the oil oxidized over 400 meq/kg in PV was needed to observe the depression of the weight in rat. Therefore, the oil oxidized to around 100meq/kg in PV was recognized as safe in that paper.

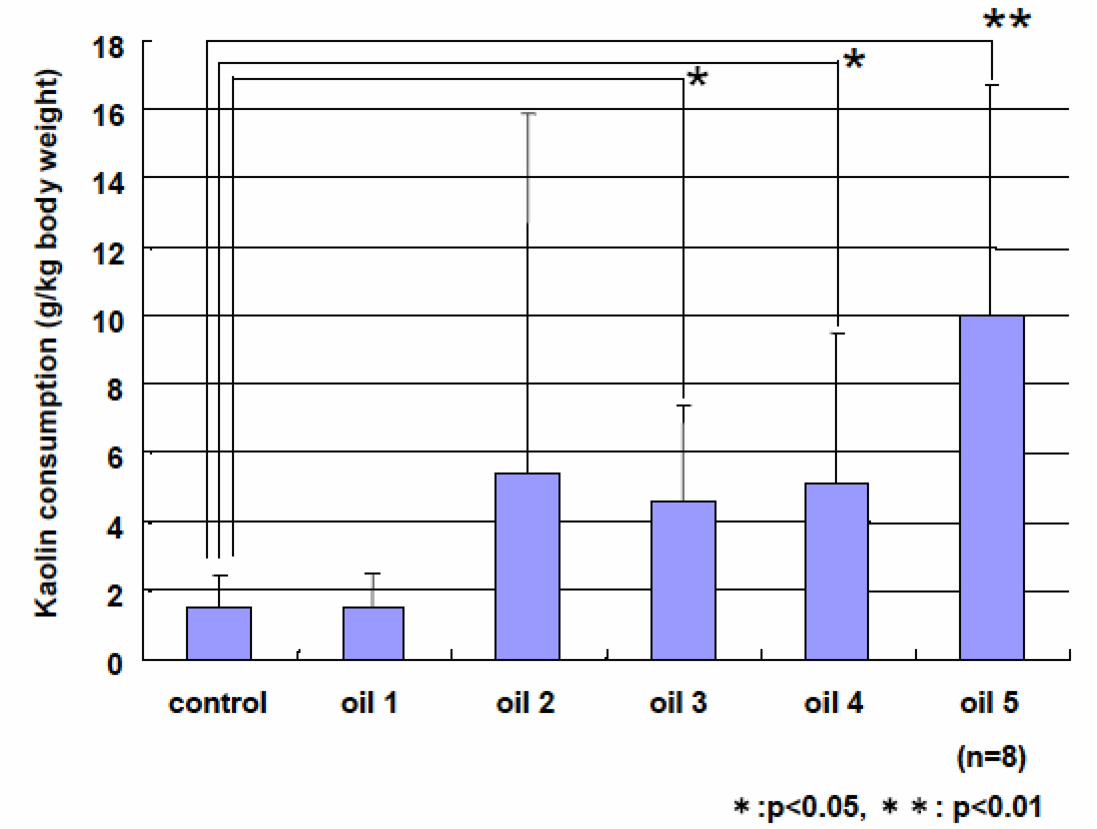

Figure 4. The comparison of kaolin consumption among control oil group and 5 kinds of oxidized oil groups. The control oil is extracted from not oxidized Instant Noodle. All kinds of oxidized oil were extracted from Instant Noodle exposed under sunlight in summer. The degradation degree of the oil increases with the sample number. Peroxide value of each oil is shown below.

Control: 2.1 meq/kg, Oil 1: 85.0 meq/kg, Oil 2: 107.2 meq/kg, Oil 3: 138.5 meq/kg,

Oil 4: 302.0 meq/kg, Oil 5: 334.0 meq/kg

However, harmful symptom was expressed when the oil oxidized to 138.5 meq/kg in PV was administrated in this pica experiment. Probably these would be correlated to nausea and vomiting in human and this level of oxidation is also harm to mice.

Summary

Oxidation of the oil is very apprehensive phenomenon for food safety because it involves formation of lipid hydroperoxide (indicated by PV) and the secondary oil oxidized product. This change can be measured by only PV, not by AV because PV and AV do not increase simultaneously. Consequently, measuring PV in oil is very important matter to grasp the deterioration level of the oil in food from the food safety point of view. The formation of lipid hydroperoxide is slow at first, however, it increase at an explosive pace after finish the induction period. To prevent this explosive increase of lipid hydroperoxide, to keep the PV at low level, 30 meq/kg in Japan, is a significant point.

From the point of view of keep the food safety, Japan strongly proposes including PV in food standard of Instant Noodle.

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1949	Spectrophometric Studies of the Oxidation of Fats. V . Coupled Oxidation of Carotene	Holman, R. T.	Archives Biochem.	21	51-57
1950	Spectrophometric Studies of the Oxidation of Fats. IX. Coupled Oxidation of Vitamin A Acetate	Holman, R. T.	Archives Biochem.	26	85-91
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<u>ISA</u>

The International Sweeteners Association (ISA) - representing manufacturers and industrial users of high intensity sweeteners – would like to make the below comment on document ALINORM 04/27/12 Appendix XXVII "Priority List of Food Additives, Contaminants and Naturally Occurring Toxicants proposed for evaluation by JECFA"**.**

<u>Aspartame acesulfame salt – revision of specifications</u>

The Dutch delegation has proposed to correct a few errors that appear in the current specifications for aspartame acesulfame salt. **ISA fully supports the Dutch proposal** to**:**

- delete the text "after adjusting the pH to alkalinity" in the description of the process;
- change the text under Solubility to "Sparingly soluble in water; slightly soluble in ethanol";

- change the number 0.643 under Specific Rotation to 0.646.

The former two points were simply entered wrongly into the JECFA specifications while the latter point was entered due to an error made by the producer of aspartame acesulfame salt; they used a slightly wrong number for the molecular weight of aspartame. Using the correct number, the end result is 0.646 and not 0.643. The producer hopes to have this corrected.

When the European Commission in September 2003 issued a draft proposal for purity criteria for aspartame acesulfame salt, it based its text on the JECFA specifications, including the errors referred to above. ISA pointed out the errors to the Commission who agreed to have them corrected in the text that was adopted on 16 April 2004 (please see Commission Directive enclosed).

ISA supports the Dutch delegations' request for the errors now to be corrected in the JECFA specifications. Our comments will also be formally submitted to JECFA upon their call for data for the 65th meeting on food additives next June.