IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Study On Adulteration Of Milk And Milk Products: A Review

Kajal Singh[1], Anil K Dwivedi[1], C.O. Samuel[2], Tulika Sharma[3]

[1]Pollution and Environmental Assay Research Laboratory (PEARL); Department of Botany, D.D.U. Gorakhpur University, Gorakhpur – 273009, U.P., India

[2]Department of Botany; St. Andrews P.G. College, Gorakhpur – 273001; U.P., India

[3]Department of Chemistry; Banaras Hindu University, Varanasi- 221005; U.P., India

ABSTRACT

Milk is such type of liquid food product which can be easily adulterated and is a very composite mixture. It is the normal mammary secretion derived from complete milking of healthy milch animal either addition there to or extraction there from. It is very valuable food which is easily digested and absorbed. It contains more than 100 nutrients which are present either in solution, suspension or emulsion in water, the most important is the casein, which is the major milk protein, lactose (which is a milk sugar), whey as well as mineral salt which are needed for the proper growth and maintenance for the human body.

KEYWORDS: Milk adulteration, Adulterants, health hazards, Detection Method.

INTRODUCTION

Milk adulteration is an action of deliberately reduce the quality of food offered for sale either by substitution of foreign substances or by the removal of some valuable ingredients. Milk used by the removal of some valuable ingredients. Milk used by the people for their consumption is adulterated or contaminated to such an extent that there is very less nutritive value in it and may also be toxic for public health. The nature of adulterants generally come across in milk and milk products are water, removal of fat, addition of skim milk powder, redevelop milk, thickening factors like starch, flour, glucose, urea, salt, chlorine etc (Kumar et el., 2015).

The cause of adulteration of milk is done to increase its volume and then starch and other redeveloped milk powders are added to increase its viscosity (Das et al., 2015).

Milk and milk products are the major part of our diet and a huge amount of our food consumption goes on milk and other milk products (Maurya et al., 2017).

Adulteration of milk is a social issue. It exists in both developing as well as developed countries. Adulterated milk consumption causes serious health issues and a great concern to the food industry. The most common adulterants which are found in milk are starch, chlorine, hydrated lime, sodium carbonate, formalin and ammonium sulfate. Milk in its original form has high nutritive value. It supplies nutrients like proteins, fat, carbohydrates, vitamins and minerals in average amount in an easily digestible form (Swathi and Kauser, 2015).

Now-a days milk adulteration is a common social issue. Besides from the ethical and economical issue, it also develops health hazards. Some of these adulterants may cause kidney diseases, skin diseases, eye and heart problem or it may lead to cancer, so far preventing such type of diseases, detection and control of milk adulteration is very common (Jay and Krishnakumar,2017).

Milk is considered as the most perfect food for adults. It contains all the vital nutrients which are required for body in considerable amount. Milk is necessary for promoting growth and maintenance of health. Milk contains sugar, fat, proteins, minerals and vitamins. Milk is also one of the best sources of calcium for both children and adults (Suradkar et al., 2015).

Milk is a substance, when it is found in its natural state then it has high food value. It provides nutrients like proteins, fat, carbohydrates, vitamins and minerals in average amounts in an easily digestible form. Milk is one of the most important food substances to human being just because of its nutritive value (Nayak, 2017).

As we know that the milk is that product which is best and cheapest source of nutrition and all the age group in rural as well as in urban areas easily accepted and used for their daily diet. Milk contains perceptible amount of fats and protein and also provide body building vitamin as well as energy giving lactose and many more nutrients which are good food for pregnant female and newly born babies. Milk can also provide a wide range of available nutrients to maintain health and normal growth of body (Hande, 2015).

ADULTERATION

Adulteration is also a process which occurs when contaminants are added to the food stuffs to getting more profits and by this process food stuffs refers to failure the hygiene rules (Matthew et al.,2019).

Adulteration is major problem faces the world and developing countries are higher risks associated with this problem, due to lack of best monitoring and policies. In developing countries, the milk consumption is a significant part of the diet for a high proportion. As a result, due to high demand, high growth competition in the dairy markets and increasing complexity of supply chain and it is the major cause of milk adulteration/ fraud. Water is the most common adulterant which is added into the milk which decreases the nutritional value of milk (Salih and Yang, 2017).

According to Gautam and Singh (2013) Adulteration is that process by which the nature of a given product is diminished by the addition of a foreign substance and the removal of an important element and it causes various adverse effects on human health. In our daily life, adulteration is regarded as one of the major problems and its adverse effects on human health is just because of their daily used food items like cereals, pulses, fruits, vegetables, milk and milk products and spices.

From the beginning of civilization, the adulteration has been one of the bigger problems for living being. Like it not only lowers the quality of food products but also causes a number of harmful effects on health. Authentic testing of food and detection of adulterant in various

*-

food product is needed for valuable assessment and to ensure the consumer protection against the food fraud. Through this review we planned to colligate various types of adulterations made in different food products, the health issues caused by these adulterants and detection methods available for them (Bansal et al., 2015).

Now-a-days adulteration has become a worldwide issue. When peoples consume such types of adulterated food products then it can severely affect the public health by producing numerous acute and chronic diseases. Adulteration of food deceives the consumers and can cause several adverse effects on their health. Toxication and contamination of metallic compounds like lead, arsenic etc and harmful chemicals like pesticides in our daily used food products and milk has been found which is highly toxic and carcinogenic in nature (Rahman et al., 2015).

Adulteration of food deceives the consumers and can cause several adverse effects on their health. Toxication and contamination of metallic compounds like lead, arsenic etc and harmful chemicals like pesticides in our daily used food products and milk has been found which is highly toxic and carcinogenic in nature. It was supposed that about 70% of deaths are to be food borne origin. The endanger of food contamination and toxicity can be minimized at levels of food supply and consumption by vigilant and active food inspectors. Mostly least educated peoples had low income, low awareness, low knowledge about their rights and responsibilities about food adulteration. Due to lack of high income, the low-income people can't choose the standard items. Therefore, the Government should be conduct awareness program, campaigns and monitoring agencies to aware such kinds of peoples about food adulteration and their harmful effects on their health (Srinivas et al.,2017).

Adulteration is also a process in which any substances are added or removed from food, due to which the natural composition and the quality of food is affected. Thus, the adulterated food become impure, unsafe and not nutritious (Quadros et al., 2018).

Adulteration in food products can cause dreadful effects on human health. It can be stopped by few alerting steps which is taken by our society. Departure of food products should be checked by Government. It is important that the consumer should buying the food from the proper hygienic conditions. The food stores either local or branded both are inspected by the Government bodies (Chaudhary et al., 2020).

Within past few decades, adulteration has become one of the most popular phenomena. The researcher has not been found that the actual health effects of adulterated food which was caused by the consumption of humans. The health experts proved that after the consumption of long period of such type of adulterated food products causes slow poisoning. Many of these products are cancer causing and some causes adverse effects on human digestive system and also affecting the liver, heart and most of the organs (Hosen et al.,2013).

Adulteration is an act of intentionally lowering the quality of food which is offered for sale either by mixing or substitution of inferior substances or removal of some vital substances. Food adulteration is not only the intentional addition or removal of substances which affects the nature, substances and quality of food products but also their incidental contamination during the period of growth, harvesting, storage, processing, transport and distribution (Aishwarya and Duza**,** 2017).

The main reason of adulteration is done either for financial gain, carelessness and lack in proper hygienic condition during storing, processing, transportation and marketing. Ignorance and improper market behavior may endanger consumer health and can lead to poisoning. The study showed that majority of the food products which are sold in small retail shops of lower socio-economic localities were adulterated with physical as well as various harmful adulterants such as dyes and argemone oil etc. Therefore, it is necessary to intensify the check for adulterants which are found in majority of the food products and are sold in small quantities as various household products (Farzana, 2016).

Adulteration of milk debasing the quality of milk and can even make it harmful to human health. There are various adulterants are found in milk namely, soap, acid starch, table sugars and various chemicals like formalin may be added to the milk. Out of which, most of the chemicals are used as an adulterant which are poisonous and causes various health hazards (Malpani et al., 2018).

ADULTERANTS

An adulterant is a substance which is found in other substances like food, cosmetics, pharmaceuticals, fuels or other chemicals that deals the effectiveness of that substances. In any food products, usually the adulterants are added to increase its volume, weight etc either decrease its costing (Chug and kaur, 2021).

The adulterants are those poisonous substances, which are added into the food products then, the food becomes adulterated and which may make it harmful to human being (Manasha and Janani, 2016).

The adulterants are those chemical substances which should not be added into the food for legitimate or other health issues. By which the food becomes impure and unsafe for consumption (Mishra, 2016).

The adulterants are that substances which are added or removed from the food products and affects the natural composition and nutritional quality of food products or the substances that is used to reduce the quality of food products is known as adulterants. These adulterants are added in our daily used food products and are harmful for health and it can also cause cancer and some hazardous effect too (Jaiswal et al., 2016).

Food adulterants resulting from food manufacturing and processing can also cause adverse effect on human health. These causes various types of diseases like cancer, cardiovascular diseases, kidney and liver disfunction, hormonal imbalance, reproductive disorders, immune system suppression, mental health problems etc. There are several chemicals which are used as an adulterant like formalin, calcium carbide, melamine, histamine etc. which can cause adverse effect on human health (Mridha, 2011).

If the adulterants are present in the food items, then the food becomes more poisonous for human consumption. In another words the substance which are responsible for the degradation or lowering the nutritive quality of food products are called as adulterant (Nagvanshi, 2015).

MILK PRODUCTS THEIR ADULTERANTS AND HEALTH HAZARDS ON HUMAN HEALTH

According to Das et al., (2015) Chlorine is an adulterant which is found in milk and can cause clogging in arteries and develop heart problems. Antibiotics, causes Mastitis (a most common disease in dairy cattle). In the dairy cattle, Mastitis is one of the persistent, inflammatory reaction the udder tissue. Color, many food colorants are also added to improve the appearance and has hazardous effect on health. Pesticides, used to kill the micro-organisms present in milk. Their presence in milk causes serious health hazards due to toxicity or carcinogenicity. Neutralizers, hydrated lime, sodium hydroxide, sodium carbonate or sodium bicarbonate are added into the milk as an adulterant. It can cause cancer, hypertension and heart ailments etc. Urea, it is the most common milk adulterant to increase the shelf life is addition of urea to milk. It causes various health hazards like acidity, indigestion, ulcers and cancers. Water, it is the most common adulterant which is found in milk. It decreases the nutritional value of milk which causes various harmful effect on human health.

According to Barham et al., (2014) Various adulterants like water, starch, flour, skimmed milk powder, whey etc and some chemicals like hydrogen peroxide, carbonates, antibiotics and some lethal chemicals like formalin, detergents etc which causes more serious issues in the dairy sector. However, these adulterants reduce the nutritional quality of milk and may cause serious health hazards on human being like, gastrointestinal problems including gastric ulcer, diarrhea, colon ulcer and kidney problem etc.

According to Aishwarya and Duza (2017) Synthetic milk is an adulterant, which is found in milk. After drinking such type of synthetic milk, it gives very bad impact on human health and causes very serious harms on human body causing swelling in the eyes and complications in liver and kidney. Out of this, synthetic milk proves deadly for pregnant women and patients suffering from conditions of heart ailments and blood pressure.

According to Maurya et al., (2017) There are several preservatives which are found in milk like formalin and also some antibiotics are added to increase its shelf life. The addition of both antibiotics as well as preservatives decreases the nutritive value of milk and these causes very serious health hazards on human being like gastrointestinal diseases, heart problems etc.

According to Navale and Gupta, (2016) Detergents are an adulterant which is found in milk. They added to emulsify and dissolve the oil in water and then giving a frothy solution. This shows white color of milk. It causes various harmful health hazards on human being. It causes gastrointestinal complications.

According to Wasupalli et al., (2015) There are various adulterants which are found in milk including starch, urea, preservatives like formalin, hydrogen peroxide, boric acid and various antibiotics. Urea is added for whitening of milk and only few amounts of urea are sufficient to bring milk in its natural state. In summer season, when environmental temperature is very high, hydrogen peroxide usually used as preservative.

According to Malpani et al., (2018) Adulteration of milk debasing the quality of milk and can even make it harmful to human health. There are various adulterants are found in milk namely soap, acid starch, table sugars and various chemicals like formalin may be added to the milk. out of which most of the chemicals are used as an adulterant which are poisonous and causes various health hazards.

DETECTION TECHNIQUES

Poonia et al., (2016) There are various methods are used to detect the adulteration in milk, the addition of water to increase the volume of milk changes its density. It was also resembled that NIR or other such methods are able to analyze samples with least or no sample preparation. The Milko Screen instrument, which is based on Fourier Transform Infrared (FIR) Spectroscopy, can also detect extraneous matter as well as other adulterants such as urea, sugar, starch and melamine in the milk. For quality and authenticity analysis of milk, the combination of advanced instrumentation used in IR spectroscopy and chemometrics provides a powerful tool.

Azad and Ahmed (2016) There is various detection technique of adulterants in milk. Qualitative detection of adulterants in milk can be easily detected by various chemical reactions whereas quantitative detections are very complex and multiple. The nature of adulterants in milk depends on the type of quantitative detection techniques. e.g., LC (Liquid Chromatography) and ELISA (Enzyme Linked Immuno Sorbent Assay) are the most common techniques used to detect foreign protein, PCR (Polymerase chain reaction) and PAGE (Polyacrylamide Gel Electrophoresis) are usually used to detect milk from different species as an adulterant in milk of an individual species.

CONCLUSION

Adulteration in milk is normally present in its most unprocessed form. Banned substances are often added or sometimes the milk is totally reduced by synthetic milk. This is done for financial gain. But sometimes, carelessness and lack of proper hygienic condition of processing, storing, transportation and marketing, causes adulteration. This type of adulteration is totally common in developing countries.

Consumers are either cheated by sellers or often become victim of various diseases after consuming such type of adulterated milk. There are various diseases like hypertension, renal diseases, skin, eye, heart problem and cancer are some of the common diseases caused by consuming adulterated milk.

References

1. Aishwarya, M.N.L., Dr. M.B. Duza (2017) A Review on Adulteration of Milk, IAJPR,7(08): 630-637.
2. Azad, T and S. Ahmed (2016) Common Milk Adulteration and their Detection Techniques, IJFC, 3(22): 1-9.
3. Ali, A., M.S. Mahmood, J. Hussain and M. Akhtar (2011) Adulteration and Microbiological Quality of Milk (A Review), PJN, 10(12): 1195-1202.
4. Biswas, R (2019) Adulteration in Milk: A Growing Concern, JDVS, 9(1): 001-002.
5. Bhamare, Y.R., M.B. Matsagar and C.G. Dighavkar (2016) Impact of Milk Adulteration on Food Safety and Human Health in India: A Review, WJPPS, 5(8): 636-644.
6. Batra, N.G., A. Sharma, A. Saxena and A. Garg (2017) Evaluation of Adulterants Commonly found in Milk Samples, IJAFST, 8(1): 13-18.
7. Barham, G.S., M. Khaskhdi, A.H. Soomro and Z.A. Nizamani (2014) Screening of Adulterants and Extent of Added water in Market Milk at Central Zone of Sindh, Pakistan, IOSR- JESTFT, 8(7): 77-83.

8. Bano, I., H. Sajjad and M.Z. Khan (2019) Recognition of Adulteration in Milk: A Review, JDVS, 8(5): 001-004.
9. Barham, G.S., M. Khaskheli, A.A. Soomro, Z.A. Nizamani, A.H. Shah and G.B. Khaskheli (2018) Frequent Supply of Adulterated Milk at Southern Zone of Sindh, Pakistan, JDRT, 1(1): 1-6.
10. Bansal, S., A. Singh, M. Mangal, A. K. Mangal and S. Kumar (2015) Food Adulteration: Sources, Health risks and Detection Method, FSN: 1-82.
11. Chauhan, S.L., Priyanka, K.D. Mandal, B.R. Paul and C. Maji (2018) Adulteration of Milk: A review, IJCS, 7(1): 2055-2057.
12. Chugh, R and G. Kaur (2021) A Study on Milk Adulteration and Methods of Detection of Various Chemical Adulterants Qualitatively, IOP Conf. Ser.: Mater. Sci. Eng., 1225(012046): 1-11.
13. Chandnani, C., H. Belani, N. Bansal, M.R. Edenburgh (2019) Smart Milk Adulteration Detection, IJRTE, 8(4): 10481- 10486.
14. Das, S., B. Goswami and K. Biswas (2016) Milk Adulteration and Detection: A Review, ASP, 14(1): 4-18.
15. Francis, A., T. Dhiman and K. S. Maurya (2020) Adulteration of Milk: A Review, JST, 5(6): 37-41.
16. Farzana, C (2016) Food Adulteration in Commonly Consumed Food Ingredients, IJIR, 3(03): 12-19.
17. Gawali, S.P(2021) Common Milk Adulteration and Their Detection Technique: A Review, IJMER, 10; 2(5): 30-35.
18. Gautam, A and N. Singh (2013). Hazards of New Technology in Promoting Food Adulteration, IOSR-JESTFT, 5(1): 08-10.
19. Hande, A (2015) Analysis of Adulteration of Milk from Various Dairies in the Different Area of Amravati, IRJSE, 3(1): 12-14.
20. Hosen, S.M.Z., A. Paul, R. Dash, Md. Faisal, K.N. Sumi, S. Akhter and M. Rahman (2013). Food Adulteration – Perspective to Bangladesh, ICERIE, 795-800.
21. Joy K, J., K. Krishnakumar (2017) Milk Adulteration – A Review, IAJPR, 7(04): 8429- 8431.
22. Jaiswal, S., D. S. Yadav, M.K. Mishra and A.K. Gupta (2016) Detection of Adulterants in Spices through Chemical Method and Thin Layer Chromatography for Forensic Consideration, IJDR, 6(08): 8824-8827.
23. Kamthania, M., J. Saxena, K. Saxena, D.K. Sharma (2014) Milk Adulteration: Methods of Detection and Remedial Measures, IJETR, 2321-0869: 15-20.
24. Kumar, A., S.K. Goyal, R.C. Pradhan and R.K. Goyal (2015) A study on Status of Milk Adulterants Using in Milk of District Varanasi, South Asian J. Food Technol. Environ., 1(2): 140-143.
25. Khan, N and M. Chittora (2017) Milk Adulteration: A Chronic Fear of Real Time, IJB, 6(03): 5301-5303.
26. Luther, J.L., V.H. de Frahan and M. Lieberman (2017) Paper Test Card for Detection of Adulterated Milk, Anal Methods, 9: 5674-5683.
27. Lahankar, S.M., Dr. V. Chavan and Dr. N. Gore (2019) A Thorough Review on Milk Adulteration, its Effect on Health and Detection Tests, WJPR, 8(2): 636-646.
28. Mukhopadhyay, A., I. Debata, R.P. Kamate, N. Nagaiah, P. Rodrigues (2021) A Community- Based Study of Milk Adulteration and Childhood Malnutrition in Bangalore Rural District, India, ESHR, 4(1): 1-11.
29. Maurya, S., K. Kumar, S. Ahmad, Amarjeet, S. Khan, P. Gupta and P. Kumar (2017) Investigation of Adulterants in Milk and its Products from Lucknow City, J. Biol. Sci. Med., 3(2): 14-18.
30. Musa, M.A., S. Yang (2021) Detection and Quantification of Cow Milk Adulteration using Portable Near- Infrared Spectroscopy Combined with Chemometrics, AJAR, 17(2): 198-207.
31. Memon, M.A., M. Khaskheli, A.A. Kamboh, N.A. Soomro, A.S. Mangsi, G.S. Barham, N.A. Korejo (2018) Surveillance of Milk Adulteration and its Influence on Physico- chemical Characteristics of Milk in Hyderabad, Pakistan, IAHP, 6(1): 5-12.
32. Malpani, M.O., P.R. Rajput, Mohd. Sohel, P.S. Pande and V.D. Mane (2018) Detection of Food Adulteration in Milk and Milk Products Collected Randomly in Akola Region, WJPR, 7(5): 1179-1185.

33. Makadiya, J and A. Pandey (2015) Quality Assessment and Detection of Adulteration in Buffalo Milk Collected from Different Areas of Gandhinagar by Physico-chemical Method, IJPTR, 8(4): 602-607.
34. Memon, M.A., M. Khaskheli, A.A. Kamboh, N.A. Soomro, A.S. Mangsi, G.S. Barham, N.A. Korejo (2018) Surveillance of Milk Adulteration and its Influence on Physico- Chemical Characteristics of Milk in Hyderabad, Pakistan, JAHP, 6(1): 5-12.
35. Matthew, N.O.S, A.J. Tolulope and M.M. Sarhan (2019). Food Adulteration: Gentle Introduction, IJSET, 8(04): 786-789.
36. Manasha, S., M. Janani (2016). Food Adulteration and its Problems (intentional, accidental and natural food adulteration), IJRFM, 6(4): 131-140.
37. Mishra (2016). Additives Adulteration-Two Recent Shocking Facts: A Review, IJAR, 2(7): 675-676.
38. Mridha, Z.U. (2011). Food Safety- A Global Concern, BJMB, 4(2): 3-5.
39. Novale, D., S. Gupta (2016) Detection of an Adulteration Present in Milk and Milk Products, IJLTEMAS, 5(6): 71-74.
40. Nurseitova, M. A., G.S. Konuspayeva, A.A. Zhakhupbekova, F.B. Amutova, A.S. Omarova, A.B. Kondybayev, G.A. Bayandy, N.N. Akhmetsadykov and B. Faye (2021) Detection of Milk Fat Adulteration in Commercial Butter and Sour Cream, IJDS, 16(1): 18-28.
41. Nayak, N (2017) Detection of Different Adulterant in Different Milk Samples, RRJoDST, 6(3): 17-29.
42. Nagvanshi, D. (2015). A Study on Common Food Adulterants and Knowledge about Adulteration among Women of Raebareli District, IJHS,1(3): 05-08.
43. Poonia, A., A. Jha, R. Sharma, H. B. Singh, A.K. Rai and N. Sharma (2016) Detection of Adulteration in Milk: A Review, IJDT, 69: 1-20.
44. Patel, K.N., Dr. A. Patel (2021) Milk Adulteration and their Detection Technique, IJSDR,6(5): 190-205.
45. Quadros, K.G and Dr. R. Batt alwar (2018). Assessment of Student Awareness and Effectiveness of Planned Teaching Program Regarding adulteration of Food, IJH, 4(1): 220-223.
46. Rasheed, N., A.S. Mohammad and H. Hafeez (2018) A Comparative Assessment of the Quality of Milk Validation of Standard Brands Versus Local Milk Sold in Market, GJPPS, 5(1): 001-005.
47. Reddy, D.M., K. Venkatesh and C. V.S. Reddy (2017) Adulteration of Milk and its Detection: A Review, IJCS, 5(4): 613-617.
48. Rahaman, M.A., Md. Z. Sultan, Md. S. Rahman and Md. A. Rashid (2015). Food Adulteration: A Serious Public Health Concern in Bangladesh, BPJ, 18(1): 1-7.
49. Swathi, J.K., N. Kauser (2015) A Study on Adulteration of Milk and Milk Products from local vendors, IJBAR, 6(09): 678- 681.
50. Shinawy, S.H.H., A. M. El- Kholy, M.M.A. Zeinhom and A.Y. Gaber (2018) Detection of Adulteration in Milk and Some Dairy Products, Assiut Vet. Med. J., 64(157): 1-10.
51. Suradkar, V. B., B.B. Wankhade and S.H. Patil (2015) Study of Adulteration in Buffalo Milk Samples Collected from Different Localities of Malkapur Tahsil, JCPPS, 5(1): 22-25.
52. Singuluri, H and M.K. Sukumaran (2014) Milk Adulteration in Hyderabad, India- A Comparative Study on the Levels of Different Adulterants Present in Milk, JCGST, 5(1): 1-3.
53. Salih, M. A.M and S. Yang (2017) Common Milk Adulteration in Developing Countries Cases Study in China and Sudan: A Review, JADR, 5(4): 1-4.
54. Srinivasan, C., P. Sathya, S.V. Murlikrishnan, K. Hasan, S.V. Bharathi and Prakash (2017). IJSET, 6(1): 483-486.
55. Windarsih, A., A. Rohman, Irnawati and S. Riyanto (2021) The Combination of Vibrational Spectroscopy and Chemometrics for Analysis of Milk Products Adulteration, IJFS, 2021: 1-15.
56. Wasupalli, G.K., K. C. Sai, S. Kaur (2015) Detection of Adulterants and Mastitis in Milk Samples and Major Milk Fatty Acid Composition Estimation Using Gas Chromatography, IJPSSR, 1(1): 01-09.