



Teflon: Chemical Release

- 1,202° CF₄ [carbon tetrafluoride]: Global warming agent; irritant to heart, lungs and nerves
- 1,112° CF₃ [trifluoroacetic acid fluoride]: degrades proteins; irritant to heart, lungs and nerves
- OFCB (octafluorocyclobutane)* Linked to heart disease
- PFB (perfluorobutane): Global warming agent
- 932° COF₂ [carbonyl fluorinated version of carbon dioxide]: irritant to heart, lungs and nerves
- HF [Hydrogen fluoride]: Corrosive gas. Kills tissue
- 887° SiF₄ [silica tetrafluoride]: highly toxic by inhalation
- 680° Toxic gases:
 - TFE [tetrafluoroethylene]: animal carcinogen
 - HFP [hexafluoropropene]: weakly carcinogenic
 - TFA [trifluoroacetic acid]: poisonous
 - DFA [difluoroacetic acid]: Animal carcinogen
 - MFA [monofluoroacetic acid]: lethal to humans
 - PFOA [perfluorooctanoic acid]: animal carcinogen
- 554° Ultrafine particulate (oxidized Teflon)
- 464° Lowest recorded temperature at which Teflon particles have been released
- 396° Lowest temperature in peer-reviewed literature indicating that non-stick coatings break down, based on breathers

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A Study Report ON Uses of Non-stick Utensils: Associated Health and Environmental Impact 2017



Uses of Nonstick Utensils: Associated Health and Environmental Impact

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"This report is prepared based on secondary information, journal review and analyses, vigorous study of existing reports and online findings to ensure environmental protection by creating public awareness. The views herein shall not necessarily be taken as the official opinion of ESDO."

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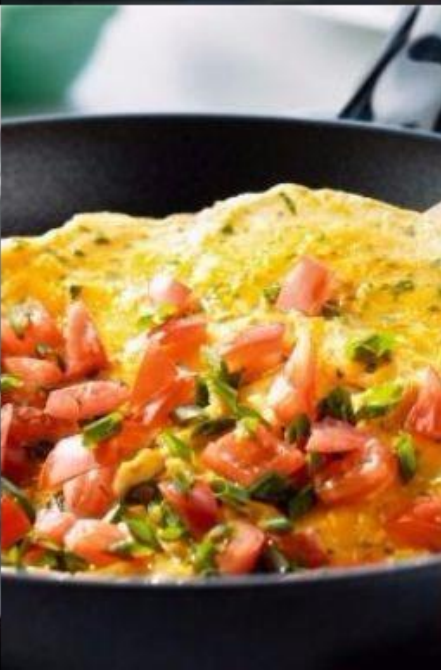
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Environment and Social Development Organization-ESDO

A Study Report
ON
**Uses of Nonstick Utensils:
Associated Health and Environmental Impact**



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Finally, this study report would not have been possible without continuous effort of ESDO team.



Environment and Social Development Organization-ESDO

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Non-stick cookware are one of the greatest inventions for culinary use ever to grace our kitchens. For decades, fluoropolymer nonstick coatings have ruled the market. Unfortunately the non-stick pan has a little bit of a bad name for itself due to the common inclusion of Teflon. Teflon was discovered in 1938 and is the brand name of 'polytetrafluoroethylene' and was the first non-stick coating for kitchenware. 95% of Americans have some detectable levels of Teflon in their blood and some of this comes from the use of Teflon coated pans.

The International Agency for Research on Cancer (IARC), part of the World Health Organization (WHO) has classified PFOA as “possibly carcinogenic to humans” (Group 2B), based on limited evidence in humans that it can cause testicular and kidney cancer, and limited evidence in lab animals.

Nonstick cookwares are used extensively in Bangladesh and many of us are unaware of the health and environmental hazards posed by its Teflon coating. Lack of knowledge about toxic fume released from Teflon coated pans upon certain heat, let us become frequent victims of this dangerous poison. This report presents the volume of uses of non-stick cookware, its production ratio, the import and marketing situation of non-stick cookware, the health and environmental impact of non-stick utensils and the level of public awareness about the issue. The report also contains background information on why manufacture and uses of non-stick pans are matters of a great concern and also proposes actions steps by the government and different stakeholders to protect the human and environmental health in Bangladesh.

According to our baseline survey about 70-80% urban household uses non-stick cookware and uses in rural parts of the country are 35-40%. It was also observed that level of awareness on the hazardous effect of Teflon/ non-stick is very poor, just 0.9% and most of the people were totally ignorant of its proper use and harmful impacts as well.

In ESDO's primary survey, it was found that cooks (mostly women), children and house pets are suffering greatly due to the toxicity of Teflon coated non-stick cookware. The major health issues observed were respiratory diseases, kidney and liver problems, infertility, delayed pregnancy and birth defect. Many pets were dying in the last 6 months due to Teflon toxicity.

From the study finding, it can be illustrated that as females mainly cook in Bangladesh, they are the worst sufferers of the PTFE exposure. In Dhaka city, huge number of women that is almost 288,118,3 probably suffer from kidney and lung complications where almost 212,153,6 mothers are likely to complain that their children are suffering from the same. Also 258,690,6 women of age group of 25-40 are supposed to be infertile or to have delayed pregnancy or miscarriage. The projection is also scary for the women in Chittagong city.



INTRODUCTION

The advancement of new technology has taken place since the beginning of human history. Every day another company brings out something more advanced in an attempt to win the consumer war against another company. This consumerism is driving the rate of advancement faster and faster each year. Technology may have negative aspects because it depends on what the use of the technology is for and who are using it; Albert Einstein once said 'Technological progress is like an axe in the hands of a pathological criminal'.¹



Such an advanced technology is nonstick technology. Nonstick cookware is a common application, where the non-stick coating allows food to brown without sticking to the pan. With other types of pans, some oil or fat is required to prevent hot food from sticking to the pan's surface. Food does not have the same tendency to stick to a non-stick surface; pans can be used with less or no oil, and are easier to clean, as residues do not stick to the surface. A non stick surface is a surface coated with polytetrafluoroethylene (PTFE).²

Do we know the real black spot of the nonstick cookware? Probably we don't. But there is a horrible dark side of this famous cookware. It is very sad that our most favorite nonstick cookware has become a nuisance for us. It is as deadly as poison. The nonstick coating is made of Teflon that contains PTFE (Polytetrafluoroethylene) which is very injurious to health. When pans are overheated beyond approximately 350 °C (660 °F) the PTFE coating begins to dissociate, releasing byproducts (PFOA) which can cause serious health issues such as **cancer, hormonal imbalance, birth defect in newborn babies, polymer fume fever in humans and can be lethal to birds**. Concerns have been raised over the possible negative effects of using PTFE-coated cooking pans.³

¹R.Rosenberg, The social impact of computers (London, Elsevier, 2004) pg 70

²https://en.wikipedia.org/wiki/Non-stick_surface

³"Safety of Teflon Non-Stick Coatings for Cookware". DuPont. Archived from the original on 2008-01-17. Retrieved 2009-05-06.

Nonstick utensils are well popular all over the world. Almost in every house non-stick pans/pots are used for cooking. The uses of non-stick cookwares have also increased in Bangladesh. In the formal sector, two industries are manufacturing non-stick cookwares and in non-formal sector, many other small cottage industries are producing and re-producing low quality non-stick products and supplying at a cheap cost. As a result the uses of these products rapidly increased. In the last five years uses of non-stick cookware spread from city to village level.

Most dangerous situations in Bangladesh is the use of cheap nonstick cookwares. Some are produced in Bangladesh and some are imported and illegally get into the local market from India and Myanmar. These nonstick cookware manufactured with Teflon nonstick mat (well know as pan fry liner sheet), which can release toxic fumes including TFE (tetrafluoroethylene), HFP (hexafluoropropene), OFCB (octafluorocyclobutane), PFIB (perfluoroisobutane), carbonyl fluoride, CF₄ (carbon tetrafluoride), TFA (trifluoroacetic acid), trifluoroacetic acid fluoride, perfluorobutane, SiF₄ (silicon tetrafluoride) even in low heat (150 °C). This study discovers that the toxic smokes are the cause of an alarming number of women and children suffering in long term illness of respiratory congestion, kidney, lung and stomach problem, suffering from infertility, delayed pregnancy or miscarriage. In an other hand survey found that the pet birds and other animals are getting affected by the serious toxin of non-stick cookware. Discarded and end of life nonstick cookware is also identified as the source of water, soil and air pollution in urban locations in Bangladesh. A poor public awareness and lack of regulation and policy, PTFE and other toxic coating cookwares getting the serious havoc to public health and environment in Bangladesh. So, it is high time we took necessary steps to sort out this serious problem.



STUDY BACKGROUND

Although non-stick cookwares are the newest addition of the latest technology, worldwide it has been scientifically proved that a non-stick coating made of Teflon that contains PTFE (Polytetrafluoroethylene) is a cause of serious health and environmental hazard. In Bangladesh, no research has been conducted yet to address the human health and environmental implications associated with non-stick utensils. Being an environmental organization, Environment and Social Development Organization-ESDO felt a responsibility to take the issue into account and conduct a research on it. As an action research organization, ESDO enthusiastically carried out the research in order to identify the health and environmental impacts of non-stick cookware and to spread the information to the general public. With a view to working up to policy level about the issue, ESDO planned the study. It took around six months to attain a general scenario of the trend of use and the level of public awareness on the impacts of hazards of non-stick coatings.

The study was conducted with the following objectives:

- a. To determine the volume of uses of non-stick cookware in Bangladesh
- b. To assess the production ratio
- c. To see the import and marketing situation of non-stick cookware in Bangladesh
- d. To analyze the health and environmental impact of non-stick utensils
- e. To assess the public awareness about the issue

The team had to depend on some secondary sources to run the study and to prepare the study report due to lack of information and lack of proper access to the findings on non-stick cookware studies in Bangladesh. We had to consult different international journals, reports, publications, academic findings, research documents, on such kind of research. No such study was found even in Asia. So probably this study is the first initiative to address the harmful consequences of non-stick cookware in Asia and the Pacific region.

After completion of the study, ESDO feels to conduct a further comprehensive study, which would include expanded field study and laboratory analysis.



The study shows an extensive knowledge of the overall country situation of non-stick cookware use, production ratio, market share, human and environmental health impacts and level of public awareness. It was observed that in urban area the uses of non-stick has highly increased and were comparatively higher in urban area than in rural area. In Bangladesh, two well known industries and 30 small cottage industries manufacture non-stick cookware. But the market is captured by the imported non-stick cookware. It was found that almost each and every household that use non-stick cookware for cooking are exposed by PTFE toxic smoke and mostly women, children and pets are exposed to Teflon toxicity. It was also found that the discarded cookware creates a serious problem and pollution to air, water and soil. According to the survey, public awareness on the toxic material of non-stick cookware is very poor. Even a huge knowledge gap was also found through this study.

Volume of Uses of Nonstick Cookware in Bangladesh

The primary study done by ESDO finds that among all the cookware used in local households the ratio of non-stick cookware to other cookware is 37:63. So, the overall use of non-stick cookware is lower compared to other conventional cookware. But, in case of frying pan the ratio is almost the opposite. The ratio of non-stick fry pans to other fry pans is 68:32. It was observed that uses of non-stick cookware in urban areas was greater than in rural area. The survey was conducted considering 1000 samples (800 from cities and 200 from villages) and the study showed that about 75-80% city dwellers use non-stick cooking pans/pots and in villages the rate of use was 35-40%.

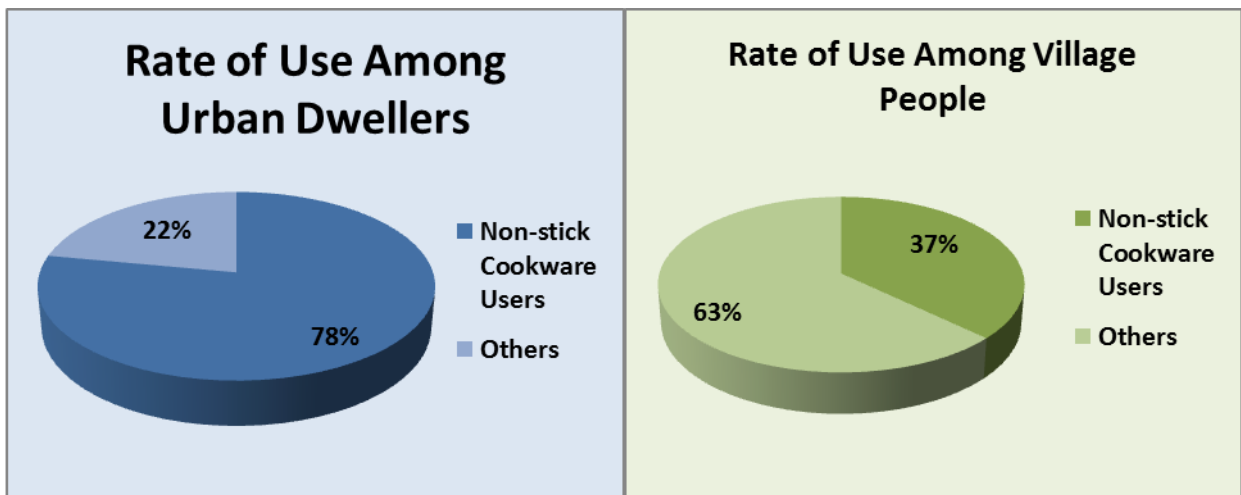


Figure 1: Rate of use of non-stick cookware in Bangladesh

The Production Ratio

It was observed that most of the quality non-stick products are made by the leading industries. They produce almost all kinds of non-stick products ranging from Saucepans to casseroles. Some known brands of cookware in Bangladesh are Kiam Metal Industries, Topper Cookware, CMX Private Ltd. etc. They produce non-stick utensils and supply throughout the country. But it is a matter of great regret that they are selling their products without any caution sign on it. In addition, they are promoting and advertising their cookware using famous TV/Film actors/actresses as models. Unknowing of the consequence of they are making it famous and people are willing to use these products.



Some of the small cottage industries use a low quality coating to produce non-stick cookware. The spray coating is so cheap that it often comes out of the pan. Some industries use non-stick liners which are more harmful.





The Import and Marketing Situation of Nonstick Cookware in Bangladesh

Studying the market share, it was observed that the cookware market is mostly captured by imported non-stick cookware. Almost 70% products come from the outside and local products constitute 30% of our total non-stick cookware. Among the foreign brands EuroSleek, Novena, Prestige, Swiss Diamond, United Cookware etc. is most popular. Among the 30% local products 17.5% were from informal sectors and 12.5% from formal sectors.

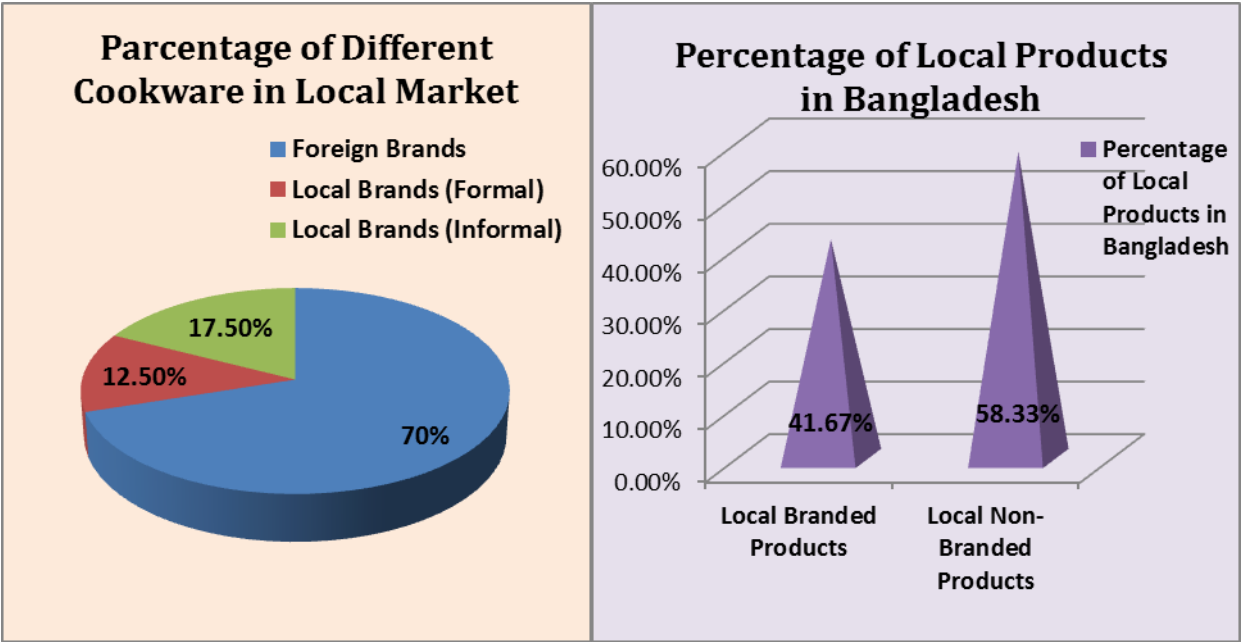


Figure 2: Market Share of Nonstick Cookware in Bangladesh

By analyzing only local products of Bangladesh it was found that local non-branded cookware constitutes almost 17.5% and local branded cookware constitutes 12.5% of total cookware. So it is obvious that the local market is filled with low quality non-branded products and it is a matter of great concern.



In Bangladesh the effect of non-stick cookware is visible and prominent. Generally, cooking in the household level is the prime responsibility of mother, wife and housemaid (usually maids are women). So women are at the highest risk of the dangerous effect of non-stick cookwares. Most of the women suffer from respiratory, kidney and liver diseases, hormonal problems, etc. A large scale of women is facing many complications regarding pregnancy and gynecological problems. From the survey of ESDO it was observed that, the prime sufferer of the toxic fumes from non-stick cookware are mostly cooked (he/she), housewives, children and house pets. The survey found that, in the capital city of Dhaka, women from almost all ages are getting exposed to the toxic fumes. The total urban population of Bangladesh has been estimated to be 592,738,01⁴ which is approximately 36% of the total population. Rural population comprises of 64 (%) of the entire population.

So approximately 118,547,60 households are there in the urban areas of Bangladesh. Dhaka, Chittagong, Sylhet, Rajshahi, Khulna, Rangpur is known to be the large cities in Bangladesh. Almost 50% of the urban population live in Dhaka while almost 13% lives in Chittagong city.⁵ It can be calculated that there are 351,960,0 households in Dhaka city and 907,800 households in Chittagong city. In households of Bangladesh, most of the cooks are female. Roughly 87.5% of them are female cook in Dhaka city, so 288,118,3 women are likely to suffer from kidney diseases and respiratory problems. Also 258,690,6 women who are aged between 25-40 suppose to suffer from infertility, delayed pregnancy or miscarriage. On the other hand, 212,153,6 mothers of Dhaka city likely to complain that their children suffer the most from respiratory and kidney diseases.



AVOID This
COOKWARE
That Can **FRY**
Your **HEALTH**



⁴ <http://www.worldometers.info/world-population/bangladesh-population/>

⁵ http://www.indexmundi.com/bangladesh/demographics_profile.html

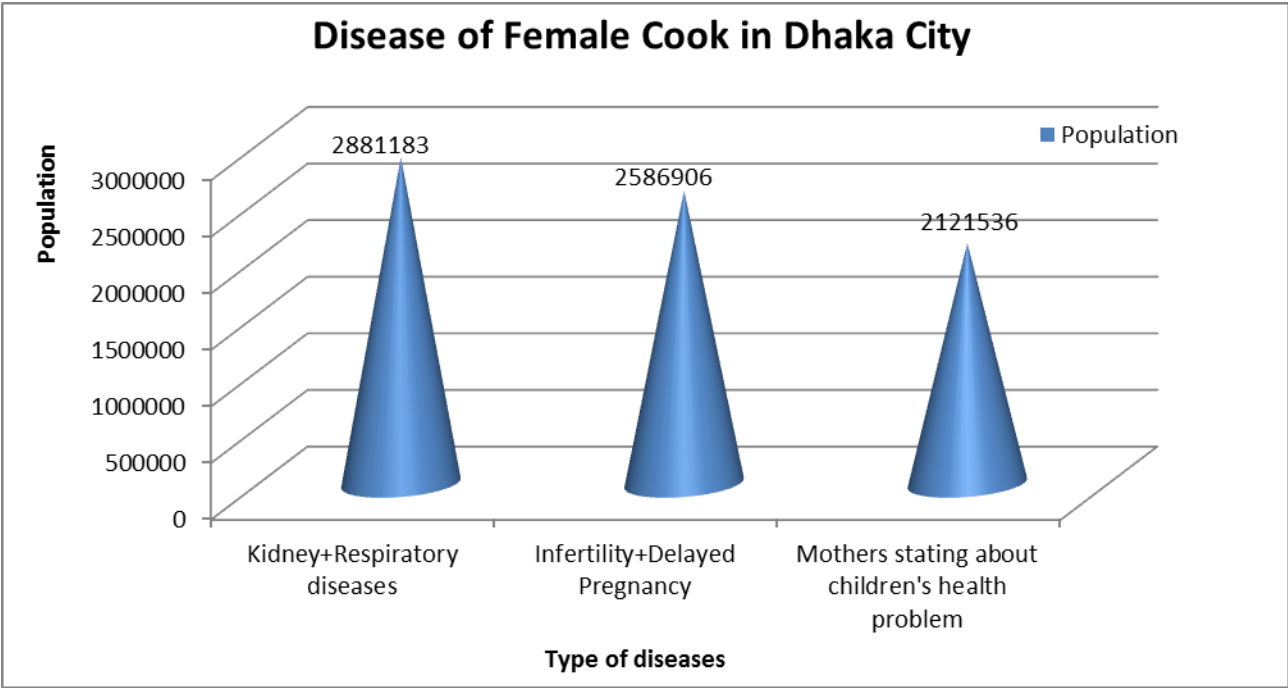


Figure 3: Population of affected people in Dhaka city due to toxic fumes from non-stick cookware

If we think about the Chittagong, the second largest city of Bangladesh, we can easily estimate that 743,135 women suffer from kidney problems and respiratory diseases. It can be projected that 667,233 women who are aged between 25-40 suppose to suffer from infertility, delayed pregnancy or miscarriage and almost 547,201 mother might state that their children suffer the most from respiratory and kidney diseases.



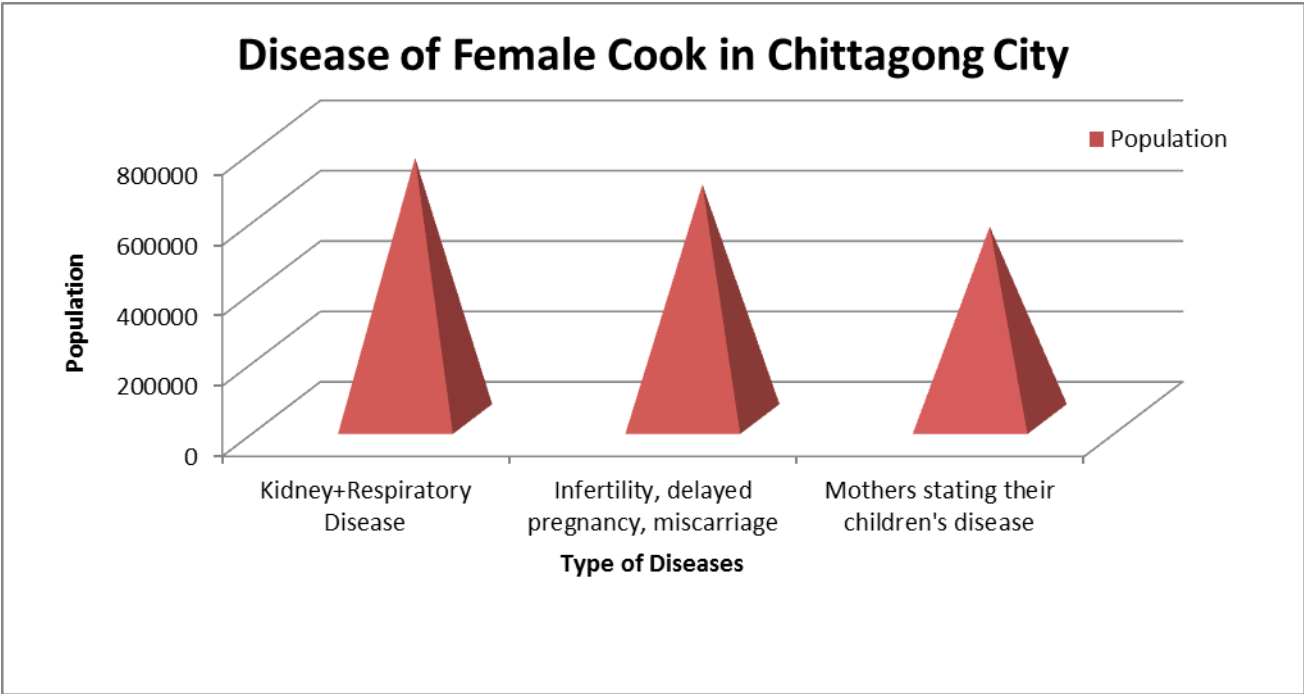


Figure 4: Population of affected people of Chittagong city due to toxic fumes from non-stick cookware

Are non-stick pans safe?

In 2006,
90%
of aluminum cookware sold had non-stick coating.

PFOA (perfluorooctanoic acid)
is a compound used in the production of PTFE. PFOA is thought to cause reproductive and developmental problems.
➤ Fortunately, PFOA transfer to food is limited.

What we don't know:

- Long term effects of repeated, small exposures to PTFE-fumes, as is the case when cooking
- Possible effects of PFOA exposure, as well as why most people in the US have PFOA in their blood

What you should do:
As long as you use your non-stick cookware **appropriately** (i.e. not overheating it, not heating it unattended, not eating the coating), non-stick coatings are **safe for use**.
But keep birds away from the kitchen!

What we know:

Overheating non-stick pans can cause release of PTFE-fumes. Cases of factory workers inhaling PTFE-fumes have documented flu-like symptoms, such as fever, coughing and headaches. Other cases of inhalation toxicity involved improper and unattended overheating of non-stick pans.

- Birds are particularly susceptible to PTFE-fumes.
- These PTFE-fumes are likely not generated under normal cooking conditions.

350°C (662°F)
Temperature at which PTFE degrades, releasing toxic particles and gases.

Fluorine
PTFE is inherently stable, thus it should pass without harm through the digestive system.

Teflon and other non-stick coatings are primarily made of **polytetrafluoroethylene (PTFE)**, a chemical with repeating groups of carbon and fluorine atoms.



EXPOSURE OF PTFE TO HOUSE PETS (Birds & Animals)

Teflon poisoning, or more correctly polytetrafluoroethylene (PTFE) intoxication, is a rapid and lethal gaseous intoxication of all species of birds. Household cookware is the most common source of PTFE exposure for pet birds and animals and problems arise when pan boil dry or unfilled saucepans are heated. This is especially a concern when the non-stick coating is damaged or aged. Frying temperatures normally range between 212-392°F; cooking oils and butter will flame and foods will smoke and burn around 500°F. Above 530°F, the coating undergoes chemical decomposition and PTFE is released. Budgerigars are the most sensitive of the birds species studied and birds have died from exposure to toxins with temperatures as low as 396°F.⁶

In cold regions the topic of Teflon poisoning seems to come up at the time of year when the house is tightly closed for winter and indoor air circulation is poor. In Bangladesh such condition prevails all over the year due to congested and ill-ventilated housing system. In ESDO's study the households were categorized into 3 classes, i.e. Upper class, Middle class and Lower Middle class.

⁶Martin E. PTFE toxicity- a potential cause of sudden death in pet birds and poultry. University of Guelph Animal Health Laboratory Newsletter. 2001; 5(3).

It was observed that the pet death rate is higher in Middle Class and Lower Middle Class households. This is mainly due to the poor ventilation system and congestion of a large number of pets in a small area. In Dhaka city the amount of independent households is less than 1%. The majority of middle class people lives in small apartments and they usually keep their pet birds in one corner of a room, or in a balcony near the kitchen. The scenario for the houses that pet dogs, cats and rabbits, were the same and those pets got an easy access to kitchen become the victim of PTFE toxicity. In case of upper class households the number of pet birds/animal death was comparatively low. According to the survey, In Dhaka City among 250 houses that pet cats or birds 211 houses lost their one or more pets within the last 6 months. The result obtained from this preliminary survey shows that how birds and other animals are getting affected by the serious toxin of non-stick cookware.

All types of birds are affected. The most common pet birds found were House Sparrow (*Passer domesticus*), Budgerigar (*Melopsittacus undulates*), Parrot (*Psittacidae*), Pigeons (*Columbidae*), Common myna/ Shalik (*Acridotheres tristis*), Rosy-Faced Love Birds (*Agapornis roseicollis*) etc. The signs observed were acute death or respiratory distress which may be quickly followed by death.

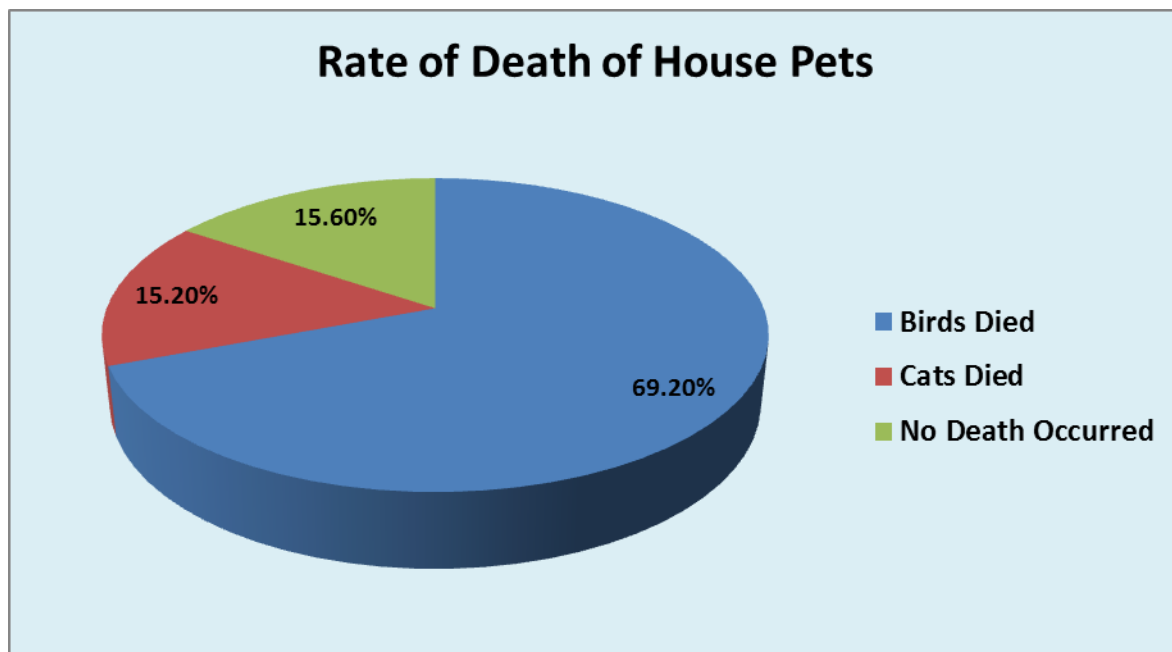


Figure 5: Rate of Death of House pets due to toxic fumes from non-stick cookware.

The toxic gas travels rapidly and birds begin to die or become ill in order of their proximity to the gas source. It is as if a bomb exploded and those closest to the blast receive the brunt of the injury; this is the pattern that PTFE displays and the smaller the bird, the less gas required to manifest the effect.⁷ So, small birds are at greatest risk.

⁷<http://www.oldworldaviaries.com/text/styles/teflon.html>

EXPOSURE TO WILD BIRDS & ANIMALS

As the toxic fume from non-stick coatings affects house birds, so it is obvious that wild birds will also get affected by inhaling this toxic gas. Nonstick cookware is readily available at the cheapest cost in the local markets of Bangladesh. People who have minimum budget can easily afford a low quality non-stick pan/pot at a reasonable price. As a result the uses of non-stick have increased rapidly and a large number of people use it for cooking. Bangladesh is a densely populated country and a great number of people live below the poverty line. According to the latest census (2016) on slum dwellers and floating population conducted by the Bangladesh Bureau of Statistics (BBS) last year, 2.23 million people live in slums across the country. These slum dwellers have their kitchens in an open space usually. So smoke from their kitchens during cooking directly goes into the air and affects the surroundings.

As a result local birds sitting on nearby trees get easily exposed to the toxic fumes from heated non-stick coatings.

In Dhaka City, Street foods are very popular and demanding. The number of street food vendors, is increasing day by day. The increasing number of food shops produces increasing amounts of toxic fumes while cooking. Thus environment gets polluted and PTFE intoxication to birds occurs. The most familiar wild bird of Bangladesh is Crow (Corvus) which is at the highest risk. Although exact death count hasn't calculated through this study, but during the survey respondents have informed frequent and abrupt death of birds, especially Crow. So, it is obvious that non-stick fume is affecting our wildlife severely and thus creating ecological imbalance.



People usually discard the non-stick cookware after fair/reasonable use of it. Vendors grab the cookware and make use of it for them. Housewives usually like to sell their used up utensils to earn some money at home. Vendors generally give the cookwares to small traders who dismantle the utensils and separate the cast iron from this. During dismantling, hazardous compounds, for example PTEE (Polytetrafluoroethylene) begins to dissociate, releasing byproducts (PFOA) which may spread to the surrounding environment, including nearby surface water and groundwater reservoirs, and also evaporate into the atmosphere. Also, when the coatings are broken, they easily transport to the nearby water bodies and agricultural land. Some of the utensils are also incinerated in an unplanned manner.

Exposure to PTEE which has a market name as Teflon might occur directly via ecological exposure, hence, the environment degrades and pollution occurs. Also, the degradation of fluorinated polymers at high temperature pump, unexpectedly large amounts of trifluoroacetic acid (TFA) into the environment.⁸

Contamination: High levels of environmental contamination can occur from dismantling of non-stick cookware putting residents in surrounding areas at risk of ecological exposure via inhalation or ingestion of contaminated water, air, and food supplies.

Air pollution: When non-stick pans are overheated beyond approximately 350° C (660 ° F), Teflon creates fumes leads to the slow breakdown of the fluorinated polymer and the generation of a litany of toxic fumes including TFE (tetrafluoroethylene), HFP (hexafluoropropene), OFCB (octafluorocyclobutane), PFIB (perfluoroisobutane), carbonyl fluoride, CF₄ (carbon tetrafluoride), TFA (trifluoroacetic acid), trifluoroacetic acid fluoride, perfluorobutane, SiF₄ (silicon tetrafluoride), HF (hydrofluoric acid), and particulate matter. Toxic substances that release from the Teflon pans during cooking may be more harmful to the environment and human health than the DDT. The more often the pans are used at high temperatures, the quicker the coating will break down and emit tiny particles and gases into the air.

Soil and ground water: Bangladesh is blessed with many rivers, rainwater reaches underground sources. If the substances are dumped then they seep into the groundwater through soil and in turn the resources become contaminated. As this happens (usually within about two years of continual use), washing Teflon-coated pans by hand or in a dishwasher with harsh detergents may accelerate the process further.

Manufacturing PFCs and the consumer products that contain them poses great risks to the environment and wildlife. The U.S. Environmental Protection Agency says PFCs present "persistence,

⁸ http://www.theecologist.org/investigations/health/269717/teflon_out_of_the_frying_pan.html

bioaccumulation, and toxicity properties to an extraordinary degree."⁹ Teflon may be responsible for an increase in long-lived environmental contaminants, according to new research from Canadian scientists. Their report, published in today's issue of *Nature*, suggests that the degradation of fluorinated polymers at high temperatures is pumping unexpectedly large amounts of trifluoroacetic acid (TFA) into the environment.

TFA enters the atmosphere when hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) break down and it exits in rainwater. (Both HCFCs and HFCs are coolant chemicals that industries now use in place of chlorofluorocarbons (CFCs), compounds that persist longer in the atmosphere and degrade the ozone layer.) When the scientists analyzed rainwater samples, however, they found more TFA than the CFC-replacement gases could explain. "We unexpectedly discovered the TFA levels have far exceeded that amount and we wanted to know why," says David A. Ellis, a University of Toronto chemist and the lead author of the study. The researchers suspected fluoropolymers, which coat surfaces as varied as frying pans to car engine parts as the likely source.

When the PTFE wastes are incinerated different toxic gases get released into the atmosphere. Among them PFOA is very persistent. Released into the environment, it looks as if it will take literally millions of years to biodegrade. The company '3M' (which once manufactured PFOA) found that it took 4.4 years for just half of it to be excreted from workers' bodies.¹⁰

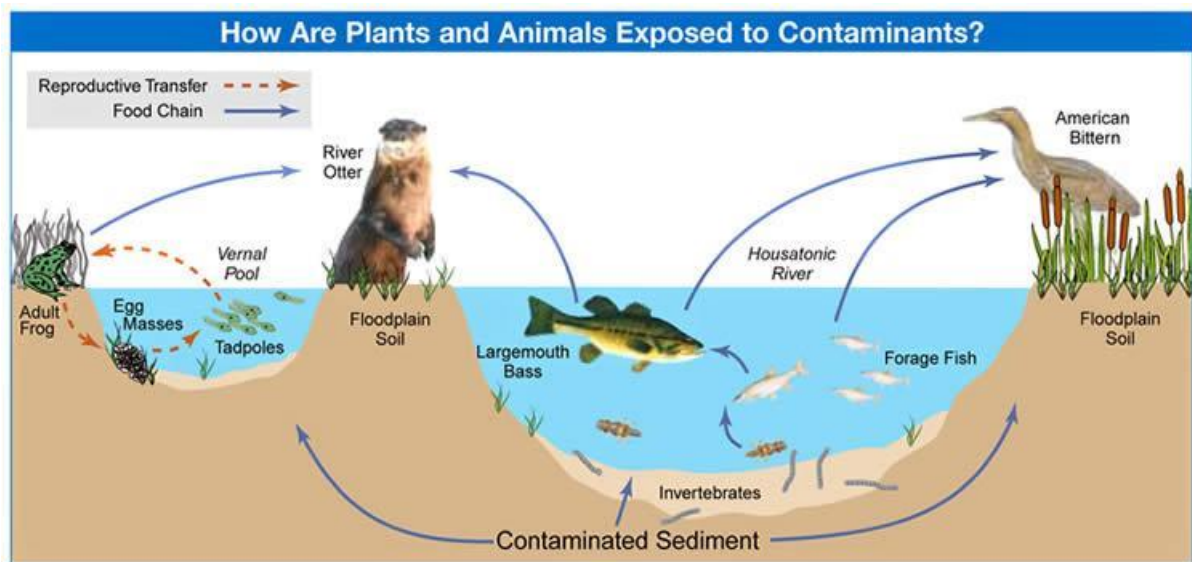


Figure 6: Environmental Impacts of Teflon

Teflon in one way or another goes into our air, water and soil and pollutes them. Air pollution from PFOA and PFOS is a serious issue. Water bodies near the manufacturing industries get readily polluted by the toxic discharges. Many of the thermal degradation products are unmatched in their environmental

⁹ <http://www.ewg.org/research/healthy-home-tips/tip-6-skip-non-stick-avoid-dangers-teflon>

¹⁰ <http://www.greenhealthwatch.com/newsstories/newslatest/latest0701/frying-pan-teflon.html>

persistence. Besides fire and heat, which are not considered normal methods of environmental degradation, some of these compounds have no known degradation methods, including four gaseous chemicals (TFA, PFOA, CF₄, PFB) and some components of the particulate matter that are highly persistent. TFA and the other PFOA-like perfluorinated acids that have been detected in Teflon degradation studies have “no known significant loss mechanism”. In addition, the perfluorinated alkene HFP, which makes up the bulk of the degradation products at temperatures above 680°F (360°C), will react with OH radicals in the troposphere to produce TFA with 100% conversion.¹¹

In 1997, companies bought more than 80,000 tonnes of fluorinated polymers for commercial uses. That sales figure continues to rise, the scientists say, and could result in the accumulation of compounds in the environment. "High concentrations of TFA in water can be mildly phytotoxic [toxic to plants] but, more importantly, it will take decades for TFA to degrade," notes Scott Mabury, a University of Toronto chemistry professor who supervised the study. "We don't know what the long-term environmental impacts are."¹²

The Dangers of Teflon

CAUTION
HIGHLY TOXIC CHEMICAL

Toxic Teflon
 Did you know the off-gas from heated teflon could kill one of your pets?
 Imagine what it is doing to you...

Non stick surfaces are one of the most overlooked health hazards

Teflon: Chemical Releases

- 1,202° CF₄ [carbon tetrafluoride]: Global warming gas; affects heart, lungs and nervous system
- 1,112° CF₃ [trifluoroacetic acid fluoride]: degrades to HF & TFCB (octafluorocyclobutane) Linked to heart palpitations
 PFB (perfluorobutane): Global warming gas
- 932° COF₂ [carbonyl fluorinated version of chemical warfare agent]
 HF [Hydrogen fluoride]: Corrosive gas. Kills tissue on contact
- 887° SiF₄ [silica tetrafluoride]: highly toxic by inhalation and ingestion
- 680° Toxic gasses released:
 TFE [tetrafluoroethylene]: animal carcinogen
 HFP [hexafluoropropene]: worker toxicant
 TFA [trifluoroacetic acid]: poisonous to plants
 DFA [difluoroacetic acid]: Animal kidney toxicant
 MFA [monofluoroacetic acid]: lethal to humans at low doses
 PFOA [perfluorooctanoic acid]: animal carcinogen
- 554° Ultrafine particulates released (oxidized Teflon particles)
- 464° Lowest recorded temperature at which vaporized Teflon particles have been measured
- 396° Lowest temperature in peer-reviewed literature indicating that non-stick coatings break down as they are heated, based on bird mortality

Fit Tip Daily.com

of Nonstick Cookingware
 PFOA perfluorooctanoate released at high temperatures

Non-Stick Cookware Know the Dangers

DR JOCKERS SUPERCHARGE YOUR HEALTH

¹¹ Ellis, DA., Mabury, SA., Martin, JW and Muir, DC. 2001. Thermolysis of fluoropolymers as a potential source of halogenated organic acids in the environment. Nature 412(6844): 321-4.

¹² <https://www.scientificamerican.com/article/teflon-parts-could-cause/>

LEVEL OF PUBLIC AWARENESS

It is a matter of great regret that most of the users are completely unaware of the danger of non-stick utensils. ESDO team has done a primary survey on the use of non-stick and awareness about the hazards among the people living in the cities as well as in villages. The survey was conducted considering 1000 samples (800 from cities and 200 from villages) and the study showed that about 75-80% city dwellers use non-stick cooking pans/pots and in villages the rate of use was 35-40%. It was observed that the rate of awareness among the people of cities and villages was 0.9%. So, it is obvious that no one is informed of the health and environmental hazards posed by non-stick cookware.

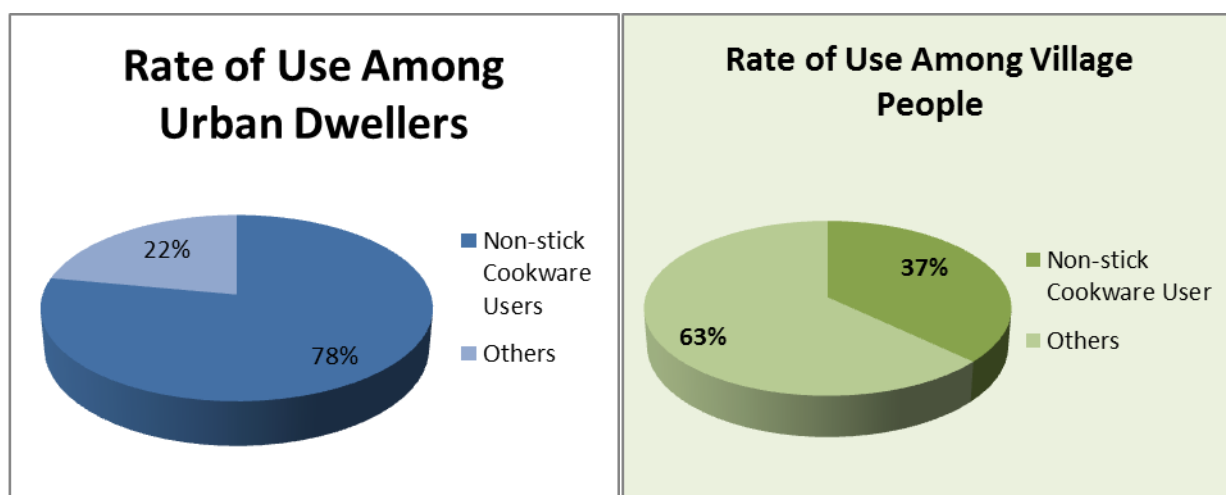


Figure 7: Rate of use of non-stick cookware in Bangladesh

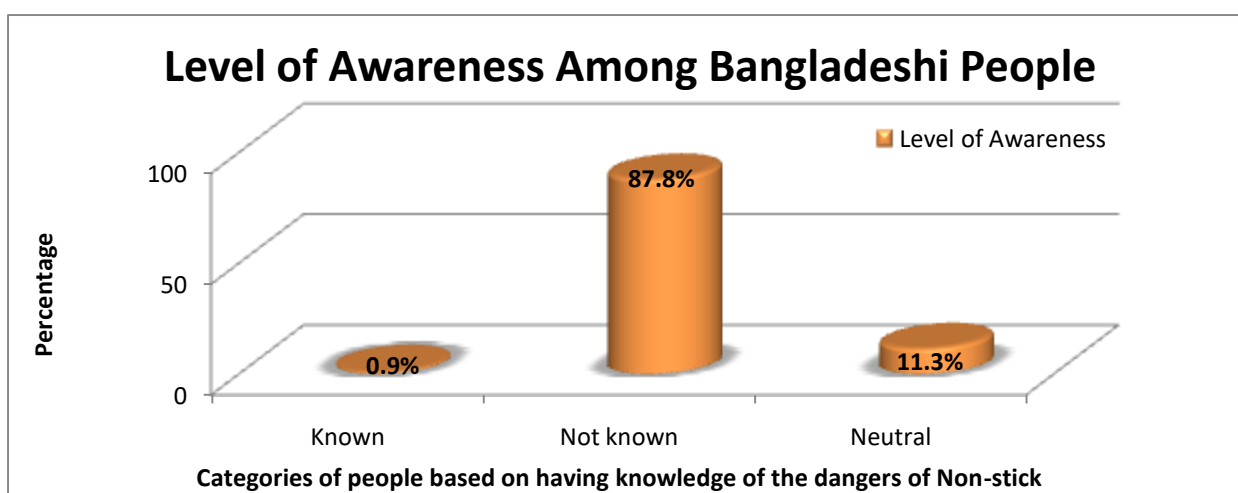


Figure 8: Level of Awareness Among Bangladeshi People

1 . Nonstick Surface

A **non-stick surface** is a surface engineered to reduce the ability of other materials to stick to it.

Non-stick cookware is a common application, where the non-stick coating allows food to brown without sticking to the pan. Non-stick surfaces are metal pans (such as aluminum pans) coated with a synthetic polymer called polytetrafluoroethylene (PTFE), also known as Teflon, a DuPont brand trademark. In the twenty-first century other coatings have been marketed as non-stick, such as anodized aluminum, ceramics, silicone, enameled cast iron, and seasoned cookware.¹³

2. What is Teflon?

Teflon is a registered trademark and a brand name owned by Chemours, and is used on a range of products. Teflon is not a specific chemical or product name. The Teflon brand represents a family of high-performance products that are used in a wide variety of industrial applications and consumer applications. The Teflon brand has come to represent a variety of benefits to consumers including easy clean, nonstick, repellency and durability.

Since the early 1960s, Teflon brand nonstick coatings have been used on cookware. Although consumers know the Teflon trademark for its nonstick properties in cookware applications, not all nonstick coated cookware contains or is made with Chemours Teflon nonstick coatings. Chemours nonstick coatings for cookware are based on food grade PTFE (polytetrafluoroethylene), which is a high-performance fluoropolymer. The final cookware coating is a dried, durable nonstick material which delivers the easy clean and nonstick performance that you expect from your cookware coated with Teflon nonstick.



Polytetrafluoroethylene (PTFE)

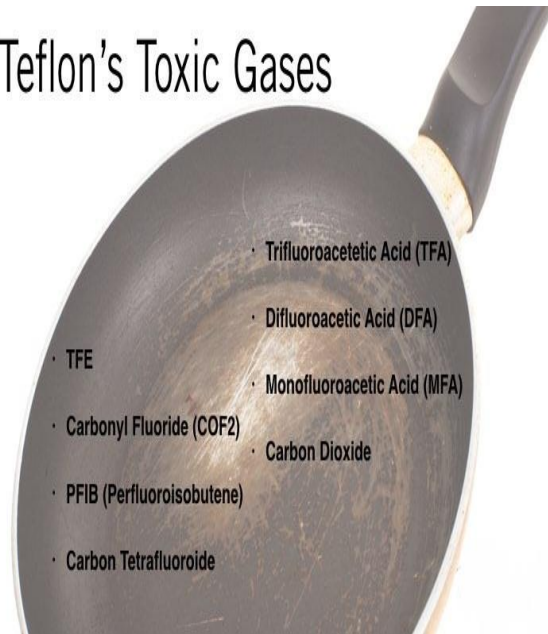
- PTFE is a fluorocarbon solid
- PTFE is hydrophobic
- PTFE has one of the lowest coefficients of friction of any solid.
- Synthetic fluoropolymer of tetrafluoroethylene
- Due to the long chain strong C bonds, PTFE is incredibly nonreactive.¹

¹³ https://en.wikipedia.org/wiki/Non-stick_surface

3. Toxic Gases Released From PTFE (Teflon)

Over the past five decades, scientists from DuPont, government, and academia have published studies documenting temperatures at which non-stick cookware coatings begin to break apart, off gassing chemicals and particulate matter into the air. Dealing with multiple cases of polymer fume fever in their workers, DuPont scientists conducted a series of studies beginning in the 1950s to identify the toxic components from heated Teflon, killing birds and rats in efforts to understand the potency of the gases and particles.

Teflon's Toxic Gases



break
of

PFOA (Perfluoro-octanoic Acid)

- An ingredient of Teflon
- Also known as 'C-8'
- A suspected carcinogen
- PFOA is very persistent
- Released from Teflon upon heat¹⁴

Some PFOA is released during the manufacture of Teflon, but the majority is given off when pans and trays with Teflon coatings are heated to normal cooking temperatures and, of course, especially when allowed to overheat or burn dry in error. The average levels of PFOA (now found in 96% of Americans) are fivefold higher than can be attributed to releases from the chimneys of chemical company DuPont's Teflon factories. The latest DuPont studies show that Teflon emits toxic PFOA gas particulates at 446° Fahrenheit (F), but the lowest temperature linked to emissions by an independent study is 325°F.

Teflon Decomposition Products

Studies show that thermal degradation of Teflon leads to the slow breakdown of the fluorinated polymer and the generation of a litany of toxic fumes including TFE (tetrafluoroethylene), HFP (hexafluoropropene), OFCB (octafluorocyclobutane), PFIB (perfluoroisobutane), carbonyl fluoride, CF4 (carbon tetrafluoride), TFA (trifluoroacetic acid), trifluoroacetic acid fluoride, perfluorobutane, SiF4 (silicon tetrafluoride), HF (hydrofluoric acid), and particulate matter. At least four of these gases are extremely toxic - PFIB, which is a chemical warfare agent 10 times more toxic than phosgene (COCl₂, a chemical warfare agent used during World Wars I and II), carbonyl fluoride (COF₂ which is the fluorine analog of phosgene), monofluoroacetic (MFA) acid which can kill people at low doses, and HF, a highly corrosive gas.¹⁵

¹⁴ <http://www.greenhealthwatch.com/newsstories/newslatest/latest0701/frying-pan-teflon.html>

¹⁵ <http://www.ewg.org/research/canaries-kitchen/teflon-offgas-studies>

4. Unique Uses of Teflon Coatings Across Industries

Each industry includes various applications of Teflon coatings for diversified purposes. Outside of the widely known non-stick coatings for pots and pans, a few different commercial sectors that use Teflon along with specific Teflon coated products include:

Appliances & Teflon™ Coated Kitchenware

Teflon coatings are applied to coffee maker parts, microwave dishes and ice cube trays

Teflon Coatings in Personal Care Products

Teflon coatings are applied to curling irons and hair straighteners

Pet Industry Teflon Applications

Pet toys and dishes can be coated with Teflon

Food Industry Teflon Applications

Teflon can be used in cheese molds, food packaging and containers.

Teflon Uses For Automakers and Car Part Manufacturing

Carburetor parts, automotive plungers, bypass shafts and sleeves may be coated with Teflon

Commercial and Retail Teflon Utilization

Building escalators may have Teflon coated kick panels

Energy Sector Teflon™ Practices

Solar panel equipment can benefit from Teflon coatings

Teflon in the Construction Trade

Tools and drill parts can be coated with Teflon

Teflon Uses in the Safety and Security Market

Door latches, lock parts and hinge pins can be coated with Teflon.¹⁶

Teflon is probably best-known for its role as the non-stick surface inside cookware. This is because PTFE industrial coating is one of the most slippery materials that's in existence today. In addition to being slippery, the material also brings a number of other features to the table, offering high temperature resistance, little reaction to most chemicals, and reduced stress cracking and corrosion.

¹⁶<http://www.orioncoat.com/blog/9-lesser-known-industry-applications-of-teflon/>

5. Dangers of Teflon (Non-stick)

Teflon can't stand the heat...

All temperatures are in degrees Fahrenheit.

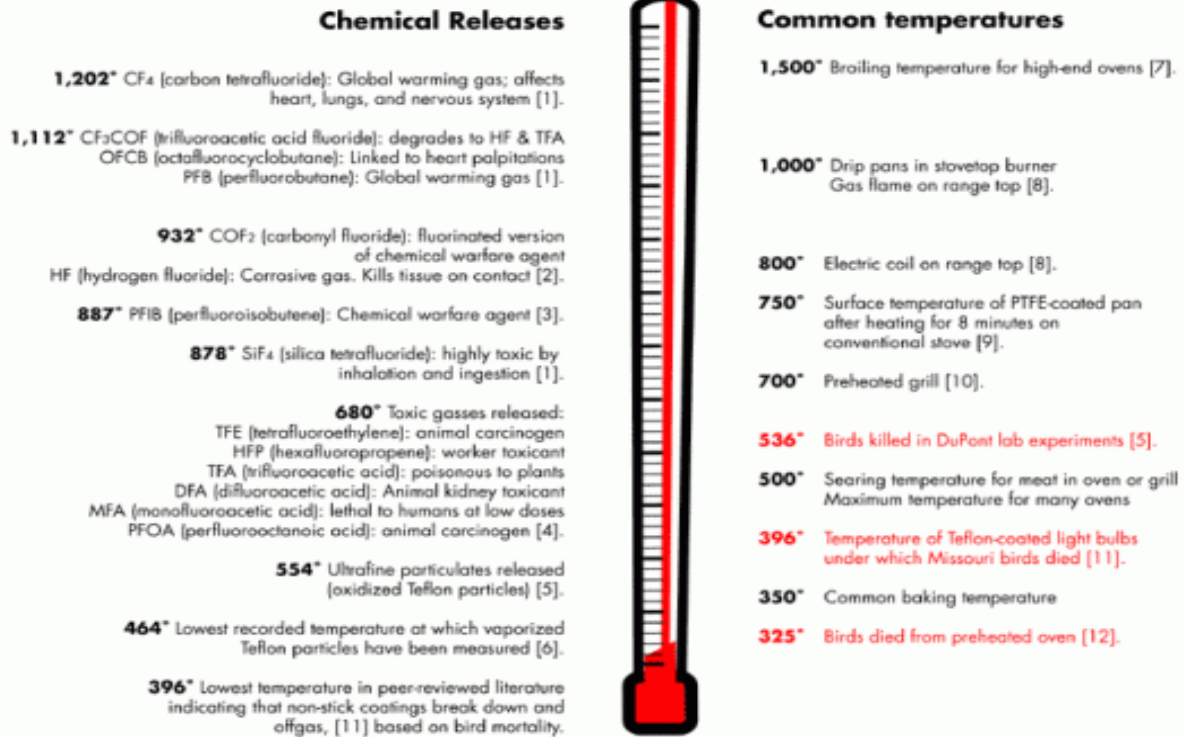


Figure 9: Heat Capacity of Teflon

Teflon pans quickly reach temperatures that cause the non-stick coating to begin breaking down, releasing toxins into the air in your kitchen. When Teflon pot or pan reaches 680 degrees F (which takes about three to five minutes of heating), at least six toxic gases are released. At 1,000 degrees F, the coatings on the cookware break down into a chemical warfare agent known as PFIB and a chemical analog of the WWII nerve gas phosgene.¹⁷



¹⁷ <http://thescienceofeating.com/wp-content/uploads/2014/09/Teflon-Dangers-e1412130445259.gif>

6. Impact on Human and Animal Health

For the time-being, most people are primarily interested in advances in slippery surfaces as they relate to cookware. About 70 percent of cookware sold in the United States contains a non-stick coating that makes cleanup a breeze. But like so many products developed for the sake of convenience without concern for human health, Teflon-coated cookware has proven to be a primary source of dangerous perfluorinated chemicals (PFOAs).

6.1 Effect on Birds

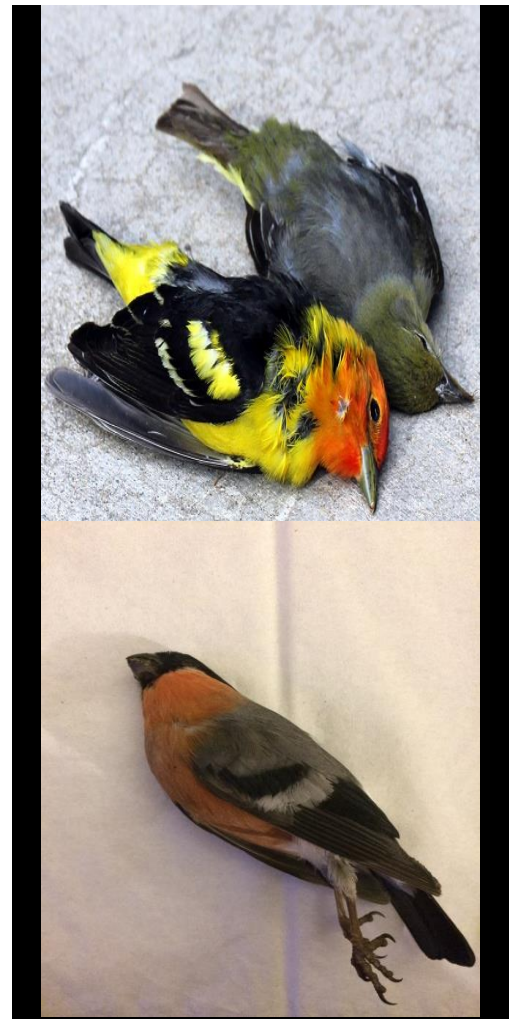
Bird enthusiasts and veterinarians have known for decades that Teflon-coated and other non-stick cookware, if heated to high temperatures, is acutely toxic to birds. If a bird inhales the toxic PFOA fumes that are produced by heated non-stick pans, its lungs will ulcerate, and it will suffocate in its own body fluids. The birds die abruptly, usually shortly after new non-stick pans are heated for the first time.¹⁸

PFCS: GLOBAL CONTAMINANTS: TEFLON AND OTHER NON-STICK PANS KILL BIRDS

April 2003

In 1975, in one of the early peer-reviewed articles on bird deaths, the authors describe the deaths of five pet birds following the owner heating a non-stick (PTFE-coated) pan:

“Five cocatiels (*Nymphicus hollandicus*) died within 30 minutes following exposure to fumes from a frying pan coated with the “non-stick” plastic polytetrafluoroethylene (PTFE) that had accidentally overheated. Within an hour the owner developed symptoms of “polymer fume fever” but recovered in the next 24 hours. Clinical signs and post mortem lesions of the cockatiels are described and reference is made to the unusual susceptibility of parakeets to the pyrolysis products of frying pans coated with PTFE.” A recent article recounts that hours after moving 2400 broiler chicks to a research warehouse at University of Columbia-Missouri, veterinarians noticed that substantial numbers of chicks were dying. Four percent of the chicks died in the first four hours, and within 72 hours more than half of the chicks were dead. After investigating the possibility of many common gas toxicants, scientists traced the deaths to lightbulbs coated with the Teflon chemical PTFE. PTFE gas intoxication has been reported in several exotic avian species, but this intoxication has not been previously reported in a poultry flock.”



¹⁸ <http://www.ewg.org/research/pfcs-global-contaminants/teflon-and-other-non-stick-pans-kill-birds>

When heated, non-stick cookware becomes a source of perfluorooctanoic acid (PFOA), a long-chain perfluorinated chemical linked to a range of health problems, including thyroid disease, infertility in women, and organ damage and developmental and reproductive problems in lab animals.

In animal studies, PFOA posed health hazards like:

- Serious changes in organs, including the brain, prostate, liver, thymus, and kidneys, showing toxicity.
- Death of several rat pups due to PFOA exposure.
- Changes in the pituitary in female rats, at all doses. The pituitary controls growth, reproduction, and many metabolic functions. Changes in the size of the pituitary indicate toxicity.

PFOA has been associated with tumors in at least four different organs in animal tests, and has been implicated in an increase in prostate cancer in PFOA plant workers.¹⁹

6.2 Effect on Human Health

Many people would say Teflon is a modern day “convenience”. Cookware coated with Teflon makes cooking and cleaning up much easier. In fact, for the past fifty years, DuPont has made a significant amount of money by making non-stick surfaces common in the marketplace. There’s just one problem – teflon is toxic and can make people sick.

6.3 Nonstick cookware causes cancer

The non-stick coating, used in Dupont Teflon pans, has been found to release one or more (up to 15) different toxic gases when heated to high temperatures. The nonstick cookware releases PFOA, which has been labeled carcinogenic by a scientific review panel that advises the U.S. Environmental Protection Agency (EPA). This is a chemical that is being used in many household products from cookware, coated paper plates and even microwave popcorn bags. DuPont let the chemicals leech into drinking water in West Virginia and Ohio. A great number of people living in these areas were diagnosed with various cancer types because of their exposure to these dangerous chemicals.



¹⁹<http://www.mercola.com/Downloads/bonus/dangers-of-nonstick-cookware/report.htm>

6.4 Other associated health impacts of Teflon i.e. PTFE are²⁰-

- Early puberty
- Reproductive disorders and infertility
- Cancer
- Autoimmune disorders
- Respiratory diseases
- Thyroid disorders
- Low birth weight
- High cholesterol
- Kidney and liver diseases
- Delayed Pregnancy
- Altered thyroid hormone regulation
- Children's health and development
- Generalized damage to the immune system
- Reproductive problems and birth defects
- Severe brain disorders
- Kidney damage
- Nervous system damage
- Liver, pancreatic, testicular, and mammary gland tumors



6.5 Dangers During the Manufacture of Nonstick

Byproducts of non-stick manufacturing can be toxic and pose risks to workers if not adequately taken care of, and overheated non-stick materials can release toxic fumes. The manufacture of many non-stick coatings involves the use of hazardous chemicals and procedures. For instance, perfluoro-octanoic acid (PFOA) is a chemical compound that is used in the manufacture of PTFE as well as other products, such as packaging, clothing and carpeting. Unfortunately, it has been labeled by the U.S. Environmental Protection Agency as a **carcinogen**. PFOA is not involved in the chemical makeup of non-stick coatings, only in production. However, because of its use during production it can cause health problems to workers in factories. A federal jury has found DuPont liable for Carla Bartlett's (worker) kidney cancer. In 1981, two out of seven pregnant workers at the Teflon plant gave birth to children with birth defects. Evidences have been found that a baby was born with one nostril whose mother was a worker in DuPont.²¹

²⁰ <http://dailyhealthkeeper.com/avoid-using-teflon-cookware/>

²¹ http://www.earthisland.org/journal/index.php/eij/article/teflons_toxic_legacy/



Figure 10: Baby Born with One Nostril due to Teflon Toxicity

Additionally, manufacturers have found no adequate substitute to the use of PFOA and, as such, continue to use it despite these findings. In a pursuit to make non-stick coating manufacturing safer, industry officials have made pledges to limit the use of PFOA and eventually phase it out of all production methods by 2015.

Dangers During Cooking

Non-stick coatings can undergo pyrolysis if heated above 260 degrees Celsius (500 degrees Fahrenheit). This means the structural and chemical integrity of the coating will begin to dissolve if this heat is reached. Heats beyond this temperature will cause severe degradation in these products and cause problems for living creatures nearby. For instance, degradation of non-stick coatings due to heat can cause fumes that will kill birds and cause flu symptoms in people.



7. Different Nonstick Coatings

Other than Teflon coating many other non-stick coatings are used in cookware, they are:

- Silicone Coatings
- Sol-Gel "Ceramic" Coatings
- Anodized Aluminum
- Enameled Cast Iron

8. Why Nonstick are getting familiar?

Nonstick cookware has plenty of benefits including requiring less oil for a healthier meal, but the Teflon that keeps the food from sticking has a **controversial past**, with experts going back and forth on whether or not it can be **harmful** to humans when heated.

1. Make amazing dishes without a drop of oil
2. Easy to clean, wash and dry
3. Scratch resistant
4. Nonstick looks stylish and modern
5. Uniform Distribution of Heat
6. Nonstick Surface on Med Devices Could Keep Bacteria at Bay²²

9. What are the alternatives to non-stick?

- Cast Iron Frying Pans
- Stainless Steel Skillets
- Stainless Steel
- Glass
- Ceramics
- Thermolon-Coated Pans

Thermolon-Coated Pans

With the growing concerns about the safety of PFOA in cookware made of PTFE, manufacturers of kitchenware have begun to develop alternative materials that can offer the same benefits as PTFE-coated pans without the potential negative health effects associated with PTFE-containing pans. Zwilling J.A. Henckels' Spirit Frying Pans, for example, Thermolon non-stick coating, a patented ceramic technology that has been hailed as the next breakthrough in nonstick cookware.

²²<http://www.rediff.com/travel-living/report/5-reasons-why-you-should-switch-to-non-stick-cookware-today/20150430.htm>

The manufacturer of Thermolon claims that this new technology is completely safe; however, like most new technologies, Thermolon suffers from a lack of extensive independent scientific research to prove – or disprove – its safety. Furthermore, the exact composition and process used to make this novel non-stick coating are not known due to trade secret practices. We do know that raw ingredients used to make Thermolon include silica, silicone, oxygen, and carbon, but that's about it.²³

10. Green Nonstick Cookware

Several businesses have developed new technologies to provide the convenience of nonstick to cook and bakeware without PFCs or other types of toxic coating. One company, Green Pan, uses a patented technology called Thermolon to make their pans non-stick and heat resistant up to high temperatures. Orgreenic makes similar products that have aluminum bases and special coatings made of a combination of ceramic and a newly-developed nonstick material that is apparently eco-friendly.²⁴

11. Campaign on Toxic Nonstick Cookware



²³<http://www.healwithfood.org/articles/non-toxic-alternatives-teflon-frying-pans.php#ixzz4aWFIJdYM>

²⁴<http://www.ecowatch.com/4-types-of-nontoxic-eco-friendly-cookware-thats-safe-for-you-and-1882023056.html>

12. Conclusion and Recommendation

Some Cookware are reactive and some are non-reactive. Ceramics and stainless steel are considered non-reactive. While these don't conduct heat very well and tend to have 'hot spots,' they won't interfere with the chemical structure of the food in such a way that changes the look or edibility of our food. Their other big advantage is that once they're hot, they stay hot for quite some time. Aluminum, copper, iron, and steel (not 'stainless') are all reactive. They conduct heat very efficiently, and therefore, do a great job of cooking our food evenly. However, these metals are reactive with acidic and alkaline foods. If you're cooking with ingredients like tomatoes or lemon juice, your food can take on a metallic flavor, especially if the cooking time is very long. Light colored foods, like eggs, can develop gray streaks. According to the food science, foods will also pick up chemical elements from reactive cookware, causing us to ingest metals like copper and iron. Our bodies process iron relatively easily, so using iron cookware regularly isn't a problem. Our bodies have a harder time, eliminating copper. When copper cookware is used to occasionally whip egg whites or sautéed vegetables, the small amount we ingest isn't enough to harm us, but you definitely don't want to use copper for every day use. To get the best of both worlds, manufacturers try to find ways to combine elements. Adding a layer of copper to the bottom of a stainless steel pan or coating iron with enamel helps to heat the pan evenly while still protecting food from direct contact with the reactive metal. Unfortunately, these kinds of cookware don't come cheap and can be hard on the wallet. In brief, use non-reactive cookware whenever your dish contains acidic or alkaline ingredients. Cookware made with reactive metals is a good choice for boiling water, sautéing vegetables, or searing meat (though don't deglaze the pan with an acid).²⁵

Risks to humans from environmental damage through technology include inhalation of dangerous chemicals in air pollution, contamination of water and food sources, and risk of infections and diseases through exposure to toxic wastes. Flora and fauna risk habitat loss or disruption and extinction of species through exposure to dangerous byproducts of technology. Greenhouse gases affect atmosphere and weather systems, causing global warming and chlorofluorocarbons that deplete the Earth's ozone layer. Technology consumes resources which are not necessary renewable, including living resources, such as forests and populations of fish, and inanimate resources, such as natural chemicals and minerals.²⁶ So we need to rethink on use of nonstick cookwares, and it is high time to say, **No to Toxic Coating Nonstick Cookware”!**

²⁵<http://www.thekitchn.com/food-science-explaining-reacti-73723>

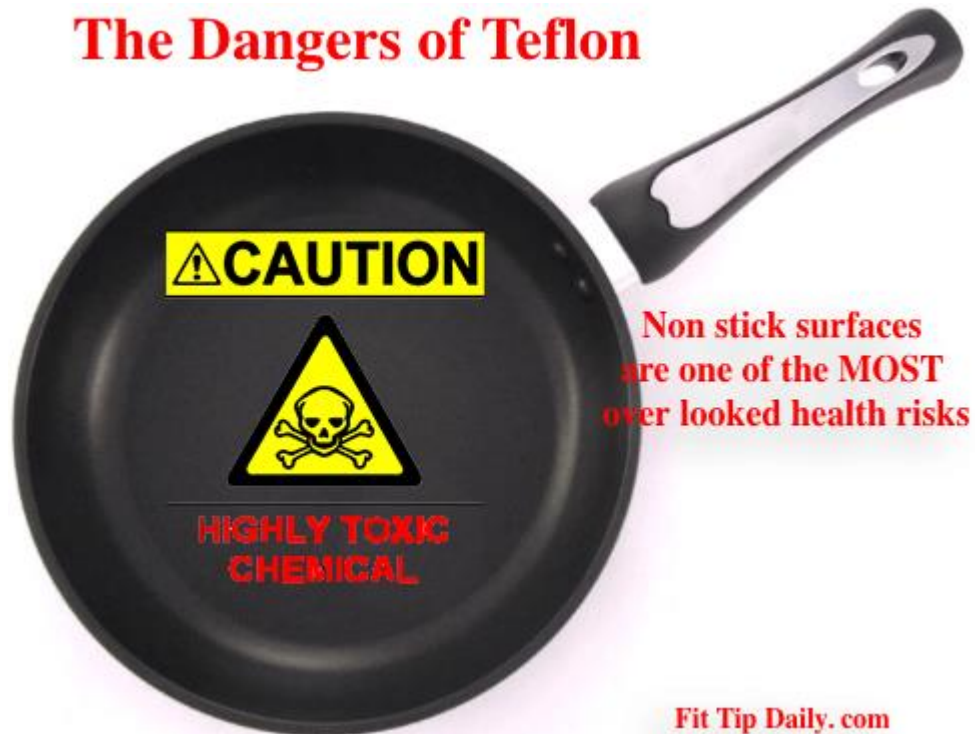
²⁶www.reference.com/science/technology-affect-environment-11ac2cb2c0ae1e30

Immediate steps should be taken in Bangladesh to prevent people from getting affected by fatal diseases and protect our environment, also to prevent the death of pet birds and animals.

ESDO recommends;

1. To create mass awareness and
2. Government initiatives to review and regulate toxic substance uses in non-stick cookware.
3. Stop production and import of Teflon/PEFT coating nonstick cookwares

The Dangers of Teflon



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Toxic Cookware



Copper



Cast Iron



Teflon



Stop Teflon, save public health: protect environment



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