Home Office

Comparison report on CS and PAVA Sprays

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Management Summary

This report has been compiled at the request of the National Policing Lead on Self Defence Arrest and Restraint (SDAR) to provide information on the similarities and differences between CS and PAVA sprays. It is based on a previous comparative study published in 2004[1], which reviewed the two approved chemical irritant solutions that were available at the time: CS in MIBK and PAVA in 50% aqueous ethanol (referred to in this document as PAVA 1). Since the publication of the 2004 review, a new solvent formulation for PAVA has been approved: PAVA in monopropylene glycol, ethanol and water (referred to in this document as PAVA 2).

The report details the technical differences between all three approved chemical irritant solutions, and compares the operational experience of officers using the sprays via information collected from officers who have used at least two of the approved sprays. Officers were asked to give a direct comparison from their experience; therefore the data collected are purely subjective and opinion-based.

The overarching theme discussed by officers when comparing CS and PAVA sprays was cross contamination of CS sprays compared with the accuracy required to use PAVA sprays. Both had benefits and disadvantages which have been described in this document. The other significant difference between the sprays is their flammability, which may be a consideration when assessing the risks when deploying the sprays with Taser; CS and PAVA 1 are flammable, PAVA 2 is non-flammable.

It is intentional that this report does not contain a conclusion. The Centre for Applied Science and Technology (CAST) recognise that there are benefits and disadvantages of each spray and, as forces have different operational needs, it is better that the decision regarding which chemical irritant spray to deploy is made locally rather than as a national standard. It is conceivable that there may be a place for both within certain forces for use in different operational situations.

[1] Comparison of CS and PAVA: Operational and Toxicological Aspects.

Contents

1. Introduction

1.1 History of chemical irritants for UK Police

In 1994 CAST (then PSDB) were requested to identify a chemical irritant spray for police use, to meet the Police Operational Requirement. Opinion at the time favoured the use of Oleoresin Capsicum (OC, commonly referred to as pepper spray) as it was already in use in the United States and some other countries. CAST consulted internationally recognised experts in the field of medicine, pathology and toxicology to establish the suitability of OC from a toxicological point of view. It soon became apparent that information on the toxicological profile of OC was lacking. Conversely, the amount of toxicological information on CS was vast; indeed the Department of Health advised that "CS was thoroughly tested to the same standards as those to which new drugs are subjected and its properties are well understood". A shift in emphasis from OC to CS resulted. This culminated in the then Home Secretary giving his full support to the issue of a CS-based irritant spray in August 1996 following a successful six-month trial. The formulation finally adopted had been used in France since 1984 and comprised a 5% solution of CS in the solvent methyl isobutyl ketone (MIBK).

CS was adopted as standard issue to routine patrol officers by all but three forces in England and Wales. Although deploying CS spray, Hertfordshire Constabulary were independently pursuing the possibility of using an alternative irritant spray based on pelargonic acid vanillylamide or PAVA. PAVA is a synthetic product based on one of the active components of OC. The advantage of PAVA over OC was that it is a single compound which makes its toxicological profile easier to assess. Sussex Police started a pilot trial with PAVA in April 2001.

In May 2002 the information available on PAVA (0.3% PAVA in a solvent of 50% aqueous ethanol) was referred to the Department of Health Independent Committees on Toxicity, Mutagenicity and Carcinogenicity in Food, Consumer Products and the Environment. The same Committees had produced a statement on the health effects of CS spray in 1999 with the overall conclusion that "the available data did not, in general, raise concerns regarding the health effects of CS itself". When the Committee produced a statement on PAVA in 2002 they recommended further work as they could not make an assessment on the health effects using the available data. These data were collected over the next two years and the Committee reconsidered PAVA in September 2004 concluding "the available information, both from the toxicity data in experimental studies, and experience in use, indicates that the low exposures arising from the use of PAVA incapacitant spray would not be expected to be associated with any significant adverse health effects". Following ministerial support for the use of PAVA, chief officers now had a choice of chemical irritant spray.

In 2007 the Committee commented on the proposal for the reformulation of PAVA spray (marketed as Captor 2 or Captor II). This comprised 0.3% PAVA in monopropylene glycol, ethanol and water. The Committee concluded that "the information submitted on the toxicological risk assessment of Captor II in relation to direct and indirect exposure, provided adequate reassurance that the risk was lower than

for the previous formulation".

All three irritant solutions are now approved for use in chemical irritant spray devices. The Committee Statements on all three solutions have been summarised in Section 5 and reproduced in the appendices.

In order to avoid confusion with the term 'incapacitant' which is used to describe tranquillisers and other similar drugs in the Chemical Weapons Convention the term 'Chemical Irritant' will be used to refer to CS and PAVA in this report.

1.2 Comparative studies

CAST produced the first comparative study of CS and PAVA sprays in 2004. This focused on operational aspects, based on discussions with officers who had used both CS and PAVA sprays from the only force at the time that had issued both sprays (North Wales). This was a subjective assessment as there are many factors that may influence the opinion of each spray and its effectiveness; therefore the information presented did not focus on statistics but what the officers thought.

The report also included the statements from the Independent Committees on Toxicity, Mutagenicity and Carcinogenicity in Food, Consumer Products and the Environment.

1.3 Review of 2004 study

This report focuses primarily on the technical differences between the three approved solutions as well as comparisons of operational experience from officers who have used at least two of the three solutions.

Many more forces are now using PAVA sprays and there is a greater level of operational experience, due to the time that has passed since the introduction of chemical irritant sprays in the UK. CAST circulated a questionnaire via the National Policing Lead on Self Defence Arrest and Restraint Practitioners' Group (SDAR Practitioners')and the Police OnLine Knowledge Area (POLKA) to capture information from officers from different forces with experiences of using the different sprays. Thirty-three responses were provided, mainly from officers with experience of using CS and either of the approved PAVA sprays, with one comparing only the two PAVA formulations.

The report is presented in two sections; firstly the technical information is detailed in Section 2. This is followed by a section detailing operational experience and opinion of the sprays (Section 3).

2. Technical Aspects

This section outlines the major technical differences between the sprays: chemical composition (Section 2.1), discharge rate (Section 2.2) and flammability (Section 2.3).

2.1 Chemical composition

There are three approved chemical formulations for police irritant sprays, as detailed in Table 1. These are referred to as CS, PAVA 1 and PAVA 2 throughout this document.

Table 1 - Chemical composition of irritant sprays.

	CS	PAVA 1	PAVA 2
Irritant (chemical name)	2-chlorobenzylidene malononitrile	Pelargonic Acid Vanillylamide	Pelargonic Acid Vanillylamide
Concentration	5% weight/volume	0.3% weight/volume	0.3% weight/volume
Solvent	Methyl isobutyl ketone (MIBK)	50% aqueous ethanol	Monopropylene glycol, ethanol, water (as per COT 2007/05)
Propellant	Nitrogen	Nitrogen	
Documented effects	Peripheral sensory irritant, which causes eye discomfort, excessive lachrimation, blepharospasm, burning sensation in the nose and throat, salivation, constricting sensation in exposed skin.	Potent sensory stimulant which primarily affects the eyes, causing closure and severe pain.	
Known adverse effects	Some adverse reactions have been seen, causing transient blistering to the skin. This has been attributed to the solvent in which CS sprays are dissolved (MIBK). These effects typically clear up within a few days.	Not known	

2.2 Discharge rate[2]

Table 2 - Discharge rate specifications for irritant sprays.

	CS	PAVA (includes both approved solvents)
Minimum limit	3.5 ml/sec	3.5 ml/sec
Maximum limit	6.5 ml/sec	13.0 ml/sec
Average discharge rate	5.0 ml/sec	Within limits set out above; however, there is a requirement for consistency between devices

Specifications differ for CS and PAVA sprays due to variances in physical properties of the solutions resulting in variances in delivery mechanisms. It is common for PAVA sprays to have higher discharge rates than CS sprays, which results in a faster jet of spray being discharged from the device.

2.3 Flammability

Table 3 - Flammability details for irritant sprays.

	CS	PAVA 1	PAVA 2
Flammability when used in conjunction with conducted energy devices	Flammable – burns with an orange flame	Flammable – burns with a blue flame which can be difficult to see in normal lighting conditions	Non-flammable

[2] Based on HOSDB Standard for CS and PAVA Sprays for Operational Police Use, Revision 1 (HOSDB 38/08).

2.4 Compatibility with other police equipment

Table 4 - Details of compatibility of irritant sprays with other police equipment.

	CS	PAVA 1	PAVA 2
Compatibility with plastics	MIBK has been shown to be destructive to a number of plastic components used in various equipment*	Not known to have any destructive effects	Not known to have any destructive effects
Breathalysers and intoximers	Not known to have an effect	Ethanol may affect readings	Not known to have an effect

* It should be noted that police equipment assessed to CAST standards should not be affected by MIBK as there is a specific requirement to assess the compatibility of equipment with MIBK within these standards.

3. Operational Aspects: Questionnaire Responses

A questionnaire was issued via SDAR Practitioners to collect data from officers within different forces that had used at least two of the three approved spray types. Thirty-three responses have been collated and summarised according to the question asked. It was clear from all responses that there were minimal perceived differences between PAVA 1 and PAVA 2 – the major differences were between CS and PAVA irritant sprays. The following sections summarise the information collected using the questions posed.

1. **What is the difference between the sprays that you have used?**

The predominant theme in response to this question was cross contamination and the need for accuracy. CS sprays were considered to cause much more cross contamination than PAVA sprays. There was no distinction between Captor 1 and PAVA 2.

CS was considered to require less accuracy when sprayed to produce an effect. This was considered a benefit in some cases as it had an effect even if the subject turned away or put their hand to their face. Additionally, it was considered better in crowds or large groups. However, there was also a disadvantage of this cross contamination as officers or bystanders may be inadvertently affected by the spray. Some officers commented that they could work through the effects, but others stated they had a bad reaction to CS which could make them virtually ineffective, hence creating a potentially dangerous environment.

In order for PAVA to be effective it must enter the eyes, therefore there is a greater need for accuracy when deploying this spray. Whilst a small number of officers suggested that this can be negative in stressful situations, it also has benefits as the spray is only considered to affect those that have been hit directly and therefore does not affect bystanders or police.

Some officers commented on the way the spray was discharged, suggesting that CS was more of an aerosol whereas PAVA was more of a jet.

Effectiveness was considered by some officers, some stating that there are not many differences between the two sprays (other than the need for getting PAVA into the eyes). However, there were some comments that suggested that you can fight through CS but not PAVA. There was also a suggestion that people can be more "immune" to CS. Effectiveness was discussed by all respondents further in question 2.

2. **Do you consider one of the sprays to be more effective than the other(s)?**

There was a very varied response to this question. Responses appeared to rely on personal preference as opposed to one spray being better than another. As with other questions there was no distinction between PAVA 1 and 2, except one comment (where the officer had only used PAVA 1 and 2 – no CS) which stated that there is less cross contamination with PAVA 2 compared with PAVA 1.

Forty-four per cent of responses showed a preference for PAVA spray. This was predominantly due to the limited cross contamination compared with CS sprays. Some stated that PAVA affects vision and that people cannot fight through it. There was one comment that CS had been used on two occasions and it was not effective in either of these; however, the officer had used PAVA numerous times on people and dogs and it was effective every time. One officer suggested that there may be slight time delay to reaction from PAVA (from instant to 30 seconds) with another saying that it is quicker in effect than CS when the target area is achieved.

Thirty-seven per cent of responses showed a preference for CS spray. This was predominantly due to the lack of necessity for accuracy (which is one of the major causes of cross contamination). It was recognised that this could cause the officer discomfort. It was suggested that you cannot guarantee deployment at the eyes for PAVA sprays, whereas CS provides more general exposure which is easier to get on target. One officer commented that there was a noticeable delay in effect with PAVA compared to CS. Another officer stated that CS is more effective than PAVA as they could not recall an occasion where compliance had not been achieved with CS, whereas they had experienced one occasion where PAVA was ineffective.

Nineteen per cent of responses had no preference, stating that there were positives and negatives to both sprays. These have been captured above; PAVA is less cross contaminating but there is less of a need for accuracy with CS spray.

3. **Are there any factors that you think change the effectiveness of the sprays (e.g. alcohol, drugs, weather conditions etc.)? Does this differ for the different types of spray?**

Responses to this question generally confirmed that there are factors that influence the effectiveness of both CS and PAVA sprays. There was no distinction between PAVA 1 and 2, with the exception of one comment which stated that PAVA 2 is very effective in wet conditions.

Most officers commented that alcohol and drugs could change the effectiveness of either CS or PAVA sprays. Whilst there is sometimes a reduced effect of either spray when used against those under the influence of alcohol or drugs, some comments referred to PAVA being more effective than CS due to the pain effect causing closure to the eyes, rendering the subject unable to see what they are doing. It was suggested that people could fight through the effects of CS. Conversely, a small number of officers thought CS was more effective in these situations.

Mental health issues were considered to be a factor that reduced the effectiveness of the sprays, although no distinction was shown between CS and PAVA from those that commented.

Weather, particularly wind, is a factor which may reduce the effectiveness of either CS or PAVA sprays. CS may disperse further in windy conditions which could be beneficial (if sprayed down wind) as it may have a more general effect; however, it could also increase the likelihood of cross contamination to officers or bystanders. As PAVA is discharged at a higher rate it was considered to be affected less by the wind; however, the need for accuracy with this spray may be a concern in these conditions. It was also suggested by one officer that rain or damp conditions could reactivate the effects of CS causing it to last longer.

One officer commented that heat, either direct sunlight or movement from outdoors to indoor (normally) heated rooms, caused increased pain when a person was subjected to PAVA spray. This was not reported for CS.

A small number of officers commented that CS could have less of an effect on people who have been previously exposed, as they knew what to expect and could fight through it; there was only one corresponding comment relating to PAVA. The mindset of the individual being sprayed was also considered a factor against effectiveness of the sprays (it was not specified whether this was CS or PAVA).

4. **How quickly do each of the sprays work? Is one faster acting than the other(s)?**

The sprays appear to work within similar time frames. Many officers considered the sprays to act roughly equally; however, some officers considered PAVA to be faster acting than CS and, on the contrary, some officers thought CS was faster acting than PAVA. There was no distinction between PAVA 1 and PAVA 2.

As with previous questions the accuracy requirements for PAVA were considered important; when it got into the eyes it was effective quickly; however, if it did not enter the eyes it would not be effective at all. If CS was sprayed in the vicinity of the subject it may take a few seconds (up to 30) to be effective; however, there would be some effect.

The response times vary depending on the individual being sprayed. This may also relate to factors influencing effectiveness as discussed in the previous section.

5. **How quickly do subjects that have been sprayed recover? Is this different for the different spray types?**

As with time to effect, time to recovery was considered roughly equal; slightly more officers thought there was a faster recovery time with PAVA. Some officers suggested that PAVA had a greater effect but these effects subsided faster than CS.

Recovery times may vary due to individual response to the sprays as well as the cooperation of the individual to allow for decontamination. There were suggestions that recovery time was between ten minutes and a few hours. A few officers commented that there is a gradual recovery period, with significant symptoms subsiding within a shorter period of time and full recovery taking longer.

One of the issues highlighted for CS was that crystals can linger on clothing and be disturbed or reactivated due to application of water some time after the subject has been sprayed. In addition, CS spray can cause some longer-term skin symptoms (up to seven days) which were referred to as flaking or dryness of the skin. No such symptoms were discussed for PAVA sprays.

It was suggested that individuals with light skin or red hair resulted in a longer recovery period for PAVA.

6. **Have you experienced any occasions when the subject that has been sprayed has had adverse reactions or reactions that last longer than expected?**

Predominantly the response to this question was negative. Five of the 33 responses highlighted issues with CS spray causing skin reactions, for example skin blistering or 'burns' to the skin. One officer had seen breathing issues, but nothing that required immediate medical attention.

The only comment referring to PAVA highlighted the possibility of the subject panicking and gulping air causing hyperventilation, as well as significant 'tearing' in response to the spray.

7. **What happens if you use the sprays in enclosed spaces? Does this differ for the different spray types? Are they all effective?**

CS has a more indiscriminate nature and is therefore prone to filling an enclosed space and is much more likely to affect everyone within it, including officers and bystanders. PAVA is much more discriminating and does not cause the same cross contamination issues, although there may still be some, usually milder, effects on others in the vicinity. There is a reduction in cross contamination for PAVA 2.

8. **Can you use the sprays(s) against groups of people? Is it effective? Is one type of spray more effective than others?**

As CS requires less accuracy to have an effect, it is easier and the preferred option to use against groups of people than PAVA which would have to enter the eyes to be effective. One officer had tried to use PAVA against a group of people and said that the first person was affected; however, others in the group had time to react and put their hands in front of their face. They did not think this would have been a problem if they had used CS. PAVA can be used against groups effectively and two officers had experience of this; however, one commented on the greater need for accuracy to ensure it gets everyone in the eyes.

9. **Have you ever used the sprays against dogs? If so were they effective? What was the outcome? Was one type of spray more effective than the others?**

Predominantly officers had not used the sprays against dogs. Some of the officers that had experience as dog handlers said that they would not use either type of spray due to the potential reaction of the dog (biting everyone and everything within its arc). These officers said there were other sprays available specifically for this use (Biteback).

Three officers had used PAVA against dogs and it was effective for each of them. One commented that it resulted in stopping the dog immediately and caused it to wander off shaking its head vigorously, sneezing and rubbing its muzzle. No officers had used CS spray.

10. **Have you experienced any effects of the sprays when you have used them? Cross contamination etc.? Did this differ for the different spray types?**

As previously discussed, there is a more significant cross contamination issue with CS spray than PAVA spray. Not only is it possible for officers to be affected by CS when it is sprayed, it can also be disturbed from the clothing of the subject when officers are in close contact with them (e.g. during an arrest).

PAVA is less cross contaminating, although officers have commented that it can affect them when they are close to the subject when it is being sprayed, as it can splash back onto their skin (which is considered bearable) or into their eyes (causing eye closure). PAVA may also take breath away and cause stinging in the eyes and nose but it was suggested that you could work through this with little effect.

There was no distinction between PAVA 1 and PAVA 2.

11. **What are your procedures for dealing with somebody that has been sprayed? What are your decontamination processes? Is there a difference between different types of sprays?**

The procedures are similar for all of the sprays. Subjects are faced into the wind, reassured that the effects are non-lasting, told not to rub eyes, and allowed to wash with cold water (washing is more predominant with PAVA). Their clothing is removed and replaced as well as contact lenses being removed by the wearer.

12. **What are your procedures for decontamination of vehicles and buildings? Does this differ for the different spray types?**

The key consideration is ventilation of vehicles and buildings. This should be followed by washing surfaces with soapy water and vacuuming fabrics. Where necessary, e.g. in hospitals, a deep clean may be required. It was considered that PAVA was easier to decontaminate than CS. There was no distinction between PAVA 1 or PAVA 2.

13. **Do you have any familiarisation training with the CS or PAVA solution for your officers? If so how do you do this?**

For CS a general exposure training spray may be used, in which a mist of spray is produced in front of officers (not directly at them) and officers walk through the residual CS in the air. Another method of familiarisation training for CS used 5% CS spray (same as operational spray) on a rag which is placed into a container. Officers at initial training only smell the container.

For PAVA a similar method to the CS has been used whereby PAVA has been sprayed onto paper towels and officers given the opportunity to smell the paper.

Not all officers have undertaken familiarisation training with either CS or PAVA, although familiarisation training is more predominant with CS sprays. This is likely to be due to the cross contamination issues seen with CS sprays being important to experience prior to operational use.

4.Summary of Differences Between Sprays

Table 5 - Summary of differences between sprays.

	CS	PAVA	PAVA 2 specific
Differences between sprays	Cross contaminating – has an effect if not very accurate but may affect officers/bystanders	Need for accuracy – must get into the eyes to be effective but little effect on officers/bystanders	n/a
Factors influencing effectiveness	Similar for all sprays (alcohol, drugs, mental health issues, weather conditions)		
Speed of action	Similar for all sprays, down to individual response		
Speed of recovery	Similar for all sprays, down to individual response		
Adverse reactions	May cause transient reddening or blistering to skin	May cause panic/gulping of air although not common	n/a
Enclosed spaces	Cross contaminating – affects everyone within room	More directed and does not cause same cross contamination issues as CS	Reduction in cross contamination compared with PAVA 1
Groups	Less accuracy required to get effect therefore may affect more people within a group	Requirement to get into the eyes makes it difficult to aim, but can be effective against a group	n/a

Use against dogs	Not tried	Used by three officers who said it was effective[3]	n/a
Cross contamination	Cross contamination is greater for CS and can affect officers/bystanders when the spray is discharged and when the CS on clothing is disturbed	May affect officers if it splashes back towards them	n/a
Decontamination of people	Subjects are faced into the wind, reassured that the effects are non-lasting, told not to rub eyes, and allowed to wash with cold water (washing is more predominant with PAVA)		
Decontamination of vehicles/buildings	Ventilation, washing with soapy water, vacuuming	As CS, but it was considered that PAVA was easier to decontaminate	n/a
Familiarisation training	General exposure mist spray or operational spray discharged onto paper towel and smelled by officers	Operational spray discharged onto paper towel and smelled by officers	n/a
Flammability	Flammable: burns with orange flames	Flammable: burns with blue flames (difficult to see in well-lit environments)	Non-flammable

[3] Dog handlers commented that they would not use either type of spray due to the potential reaction of the dog (biting everyone and everything within its arc).

5. Statements from the Committees on Toxicity, Mutagenicity and Carcinogenicity of Chemicals in Food, Consumer Products and the Environment

5.1 Statement on CS Spray (Appendix A)

In May 1999 these Committees issued a statement regarding the use of CS spray as a chemical irritant spray by the UK Police. This statement is attached in full at Appendix A.

The statement is a review of the toxicological data available on 2-chlorobenzylidene malononitrile (CS), methyl isobutyl ketone (MIBK) and the combination of the two compounds. This is followed by an assessment of the likely health effects of the operational use of the spray.

The Committees found that there was no evidence that CS caused changes in genetic material (mutagenic activity) or cancer (carcinogenic activity) where CS is likely to make contact with the body, nor does it cause birth defects (teratogenic activity). There was some evidence that CS could cause skin sensitisation (allergic dermatitis).

The Committees also found that there was no evidence that the solvent used in the spray, MIBK, caused changes in genetic material, cancer or birth defects. MIBK may cause temporary headache and nausea.

Little toxicological information was available on the combination of CS and MIBK. What information there was demonstrated that the spray does not cause serious eye damage in humans. Similarly, the spray can cause temporary reddening and irritation of the skin (dermatitis). There is no information available to determine whether people taking neuroleptic drugs are more susceptible to the effects of the spray.

In general, the Committees felt that the use of the spray did not raise concerns regarding health effects. The Committees did state that people suffering from the following conditions might be more susceptible to adverse effects from CS/MIBK exposure:

- asthma;
- chronic pulmonary obstructive disease;

- high blood pressure (hypertension);
- heart disease.

Consequently, the Committees felt that adherence to the operational guidelines regarding aftercare procedures should receive particular care, as people suffering from these conditions would not be identifiable during normal police operations.

The Committees also recommended that follow-up studies be carried out on people treated for the transient effects of CS exposure to determine whether there are any longer-term effects associated with the use of the spray such as contact allergic dermatitis. Although a mechanism for these follow-up studies was put in place in consultation with an eminent independent medical professor, volunteers were not forthcoming and the project was suspended.

5.2 Statement on PAVA 1 spray (Appendix B)

In April 2002 the Committees issued a statement on PAVA detailing areas where they felt there were insufficient data available to enable them to make a complete assessment of the health effects that could arise from the use of PAVA. Studies were commissioned during the period between this first statement and the current statement that address these gaps. The current statement together with the original statement is attached at **Error! Reference source not found.**PAVA gave a positive result in one of the three *in-vitro* mutagenicity tests carried out, indicating that it could have mutagenic potential. Because of this indication two different negative *in-vivo* test results were required. One of these, the *in-vivo* liver unscheduled DNA synthesis study, was carried out as one of the extra studies mentioned above. The other, a bone marrow micronucleus test, was carried out prior to the original statement. The negative results from these two studies led the Committees to conclude that PAVA would not be expected to be an *in-vivo* mutagen.

As no data were originally available on the reproductive toxicity of PAVA a developmental toxicity study was commissioned to assess the potential of PAVA to produce such effects. The negative results from this study led the Committees to conclude that PAVA does not give rise to any concerns regarding developmental toxicity.

The third area where the Committees asked for further information in the original statement was skin sensitisation. Although a study was commissioned to address this area the Committees questioned the quality of the work. Further evidence was gathered from the manufacturers of PAVA, which is also used in topical medical products. This evidence, taken together with experience from usage, indicated to the Committees that PAVA is not a skin sensitising agent.

The Committees did note the possibility of adverse effects in individuals suffering from asthma and recommended the continued monitoring of experience in use.

The Committees also noted that, although PAVA will irritate the eyes, the evidence suggests that there are no concerns regarding long-term effects. However, they noted that more marked effects could

occur in subjects wearing contact lenses.

5.3 Statement on PAVA 2 spray (Appendix C)

The manufacturer of this formulation, CDS, markets their PAVA products as "Captor"; the reformulated product is marketed as "Captor 2".

Information on Captor 2 was presented to the Committee on Toxicity (COT) in 2006 and further in 2007 to enable COT to provide advice on the reformulation of PAVA and whether there was any increased risk to those exposed in comparison with Captor 1.

The COT concluded the information submitted on the toxicological risk assessment of Captor II in relation to the direct and indirect exposure, provided adequate reassurance that the risk was lower than for the previous formulation (Captor I)

6. Acknowledgements

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- Officers who provided their opinions on CS and PAVA sprays
- National Policing Lead on Self Defence Arrest and Restraint Practitioners' Group

7. Glossary

Acute behavioural disorder	A state of perverted consciousness in which an irregular discharge of nervous energy goes on, causing incoherent talk, delusions, disorientation and ill-regulated muscular action.
Allergic contact dermatitis	Irritation of the skin as a result of a delayed reaction to an allergen. The reaction is widespread and susceptibility to such reactions may be genetically determined; reactions of this type are more common in those with pre-existing asthma and hayfever (allergic rhinitis). Once an individual has become sensitised to contact allergens, low amounts can subsequently elicit skin responses.
Carcinogen	A substance that has the potential to cause the production of cancer.
Chronic obstructive pulmonary disease	Chronic obstructive pulmonary disease (COPD) is a lung disease in which the lung is damaged, making it hard to breathe. In COPD, the airways – the tubes that carry air in and out of your lungs – are partly obstructed, making it difficult to get air in and out.
Dermatitis	Inflammation of the skin.
Hyperventilation	Breathing at an abnormally rapid rate at rest.
Inflammation	The reaction of the body to injury. Four main symptoms are produced: redness, heat, pain and swelling.
In vitro	Referring to biological effects that occur outside of the living body.
In vivo	Referring to biological effects that occur inside the living body.
Mucous membranes	Lining membranes of the nose, mouth and upper respiratory and gastrointestinal tracts.

Mutagen	A substance that has the potential to increase the rate of mutation in cells.
Mutation	A change in the amount or structure of the genetic material (DNA) of a cell. This can result in a change in the characteristics of the organism.
Neuroleptic drug	Anti-psychotic drug: i.e. A drug used in the treatment of psychosis.
Positional asphyxia	Suffocation as a result of body position that interferes with one's breathing.
Skin sensitisation	Production of dermatitis by contact of the skin with a substance to which the skin is sensitive, due to an immune response. Once sensitised a reaction may occur at very low levels of exposure and the effects may vary from erythema (redness) alone to a severe inflammatory reaction.
Teratogen	A substance that has the potential to cause deformities in offspring when a pregnant woman or animal is exposed to it.
Toxic	Used to describe a substance which has harmful/adverse effects.
Toxicity	The degree to which a substance is toxic.

Appendix A

COT/COM/COC statement on 2-chlorobenzylidene malononitrile and CS spray

COT 1999/06

http://cot.food.gov.uk/pdfs/csgas.pdf

Appendix B

COT statement on the use of PAVA (Nonivamide) as an incapacitant spray (COT 04/06)

http://cot.food.gov.uk/pdfs/cotstatementpava0406

COT statement on the use of PAVA (Nonivamide) as an incapacitant spray (April 2002)

http://cot.food.gov.uk/cotstatements/cotstatementsyrs/cotstatements2002/pavastatement

Appendix C

COT statement use of PAVA (nonivamide) as an incapacitant spray: reformulation of captor COT 2007/05

http://cot.food.gov.uk/pdfs/pava200705.pdf

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