ARTICLE

Synthesis and properties of novel acetamidinium salts

Zdeněk Jalový,*[a] Robert Matyáš,[a] Jan Ottis,[a] Aleš Růžička,[b] Petr Šimůnek,[c] and Miroslav Polášek [d]

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Acetamidines are starting materials for in the synthesis of synthesizing many chemicals, some of which go on to be substances, such as imidazoles, pyrimidines and triazines, which are further used for synthesis of biochemically active compounds and as well as energetic materials. Acetamidinium chloride, which is hygroscopic, is currently one of the only commercially available acetamidinium salts. The aim of this study was was to synthesize and characterize a range of acetamidinium salts that will in order to allow overcome the inconvenience connected associated with acetamidinium chloride to be avoided acetamidinium chloride, which is the only commercially available acetamidinium salt. Acetamidinium salts were synthesizeThe acetamidinium salts were characterized and characterized by with elemental analysis, mass spectrometry, NMR and, in the case of energetic salts, differential thermal analysisDTA. The structures of several previously unknown acetamidinium salts were were determined established by X-rRay diffraction analysis. Hygroscopicities of eight of the acetamidinium salts were monitored over time at in 90% humidity of eight acetamidinium salts were evaluated. The different hygroscopicity values obtained of hygroscopicity were are corroborated by the results of crystal structure analysisstructures determined by X-ray analysis. We found thatThe acetamidinium salts with two-dimensional (2D) layered structures were(acetamidinium nitrate, formate, oxalate and dinitromethanide) show a lack of not highly hygroscopic. These were the nitrate, formate, oxalate, and dinitromethanide acetamidinium salts.ity, and However, the compounds with a 3D type of structure containing rather large cavities were highly hygroscopic. These were the (acetamidinium chloride, acetate, sulfphate, and perchlorate acetamidinium salts) and possessing rather large cavities are quite hygroscopic.

Introduction

Acetamidines are used as starting reagents starting materials in the synthesis of a number of many chemicals substances, such as imidazoles, pyrimidines, and triazines, which are furtherthen used for synthesis of biochemically active or energetic compounds.[1-5] In the field of energetic materials, acetamidine is employed ina starting material for the synthesis of 2-methoxy-2-methylimidazolidine-4,5-dione[6] and 2-methylpyrimidine-4,6-diol.[7-9] Both are further transformed to 2,2-dinitroethene 1,1-ethenediamine, also known as FOX-7, or DADNE), which is an energetic materialexplosive with low sensitivity to external stimuli.[6,10]

The free base form of acetamidine is hygroscopic and it decomposes into ammonia and acetonitrile at higher temperatures.[11], and produces aAcetamidinium carbonate is formed within during 24 hone day when acetamidine is exposed to air at room temperature. when stored in contact with air [12]. Therefore, it is therefore unsuitable as a starting material, so for synthesis and the use of an acetamidinium salt is necessary for synthetic reactions.

Acetamidinium chloride (**1**) is one of the only commercially available salts of acetamidine and is Tthe most commonly used. and commercially available salt of acetamidine is acetamidinium chloride (1). It is prepared by the Pinner method from acetonitrile and alcohol in the presence of hydrogen chloride, followed by addition of aAmmonia is added to the iminoether intermediate to yield **1**. iminoether [13] Many synthetic routes for acetamidines have been reviewed.[20,21]. Reaction of acetonitrile with cobalt or nickel nitrates and oximes givesyields acetamidinium nitrate (**2**).[14,15] Another easily accessible acetamidiume salt, is acetamidinium acetate (**3**), is readily prepared by the reactionfrom of triethyl orthoacetate, ammonia, and ammonium acetate.[16] Theis method is convenient for, both for laboratory and industrial scale synthesis, anduse or the acetate may be further transformed intoto yield other salts, such ase.g. the formate (**4**)[17], sulfatephate (**5**)[18], orand dinitromethanide salts (**6**).[19] Many synthetic routes for acetamidines have been reviewed [20,21].

The main disadvantage of acetamidinium chloride is that it is its relatively hygroscopic. high hygroscopicity. The formationrelease of the free base in methanol by using the use of sodium methoxide produceswill produce sodium chloride, which is partially soluble in theis solvent (~1 g/100 mL).[22] The presence of any chloride sourse is unfavourable in certain syntheses, such ase.g. nitrations, and itsthe complete removal of chloride is tedious.[6]

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Commented [A2]: The families of compounds synthesized with acetamidines are detailed below in the Introduction. They need not be listed in the Abstract, which the journal indicates should be a brief and concise summary of the main objectives and results of the work.

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Commented [A4]: 'Determined' is a more accurate term when describing the results of an analysis. The structures themselves were established by the starting materials and reaction conditions, whereas XRD was used to analyze them.

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Please note, this may require you to add citations here. Please evaluate the revision for technical accuracy and to ensure direct correspondence between the text and your references.

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Please note, this will affect the order of citations for the references currently numbered 14-21. If you accept this revision, please update your reference list accordingly.

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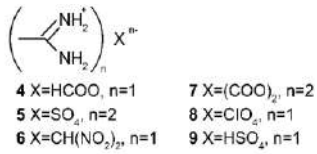
Here, we describe the synthesis, crystal~~X-ray~~ structure, hygroscopicity, and thermal stability of several of the~~ome of the~~ acetamidinium~~ne~~ salts shown in ~~listed in~~ Fig~~ure~~ 1.

Results and discussion

Synthesis



1 X=Cl, n=1 **4** X=HCOO, n=1 **7** X=$(COO)_2$, n=2
2 X=NO_3, n=1 **5** X=SO_4, n=2 **8** X=ClO_4, n=1
3 X=CH_3COO, n=1 **6** X=$CH(NO_2)_2$, n=1 **9** X=HSO_4, n=1

Fig. 1 ~~List of a~~Acetamidinium salts ~~studied~~analyzed in this study.

We previously reported a~~The~~ procedure for the preparation of acetamidinium ~~sulphate~~sulfate (**5**) from **1** ~~-~~via an ion exchange reaction ~~from acetamidinium chloride (1) was earlier described by us~~.[22] For our purposes, it may be considered a universal method for the preparation of acetamidinium salts from **1** (Fig. 2). We used ~~T~~this procedure to synthesize~~was now used for the synthesis of~~ ~~the nitrate (~~**2**, as well as ~~) and~~acetamidinium ~~the~~ oxalate (**7**). Based on a previously reported method for the preparation of **5**,[18] we obtained acetamidinium perchlorate (**8**) from **3** and perchloric acid ~~Thus, it may be considered as a universal method for the preparation of acetamidine salts starting from **1** (Figure 2).~~

~~The method used in the preparation of (5),[18] starting from acetamidine acetate and based on the reaction of the latter with an acid stronger than acetic acid, was now successfully used in the preparation of acetamidinium perchlorate (8) from 3 and perchloric acid.~~ ~~A~~cetamidinium perchlorate (We also prepared **8**)~~was also prepared~~ ~~-~~from **5** by an ion exchange reaction with barium perchlorate in water (Fig~~ure~~. 3). Acetamidinium formate (**4**) wa~~was~~s prepared from trimethyl orthoacetate and ammonium formate. A similar method has been published ~~earlier~~ by Taylor for preparation of **3**.[16]

~~The method starting with acetamidinium acetate (3) based on the reaction with a stronger acid than the one we used (acetic acid) for acetamidinium sulphate (5)[18] was now successfully used for preparation of acetamidinium perchlorate (8). This salt was also prepared from 5 by an ion exchange reaction with barium perchlorate in water (Figure (2).~~
~~Acetamidinium formate (4) was prepared from trimethyl orthoacetate and ammonium formate. A similar method has been published earlier by Taylor for preparation of 3.[16]~~

Hygroscopicities

The acetamidinium salts were weighed and stored under 90% humidity at 30 °C[23] for 1–21 days. Samples of ammonium acetate (**10**), guanidinium nitrate (**11**), and guanidinium chloride (**12**) were stored under identical conditions. The h~~H~~ygroscopicities of the samples ~~of acetamidinium salts~~were~~,~~[4] determined ~~at 90% humidity and 30°C[23] and~~ to be the percent weight increase compared with the weight of the original sample. The results are summarized in Table 1, and the changes in hygroscopicity (%) over time are plotted in ~~the comparison of these results with ammonium acetate (10), guanidinium nitrate (11) and guanidinium chloride (12) are represented as~~

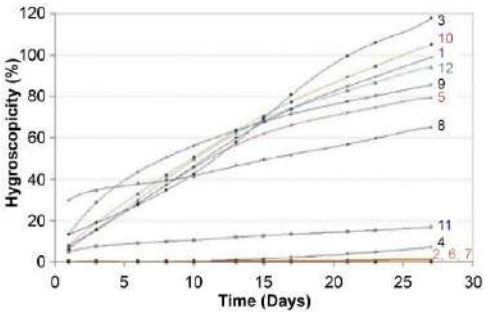


Fig. 2~~4~~ Changes in the ~~H~~hygroscopicities of acetamidinium salts (**1**-**8**) over time and comparison with ammonium acetate (**9**), guanidinium nitrate (**11**), and guanidinium perchlorate (**12**).

~~the weight increase compared with the weight of the original sample, expressed in %. The results are given in~~ Fig~~ure~~ 4. ~~and values for certain days are presented in Table 1.~~ In the case of compounds with known structures determined by X-~~r~~Ray diffraction (XRD) ~~techniques~~analysis, information about the spatial structure is also included. The influence of the structure on hygroscopicity is discussed later in this report.

X-Rray crystallography

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Please note that the manuscript contains only 4 figures, but the text refers to 11 figures in all. Please ensure that the rest of the figures are included and formatted correctly prior to submission to the journal.

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The aAcetamidinium cations may is frequently serveused as a counterions for a wide variety of anions, like simple halogenides, carboxylates, and complex metal anions and others. The The pparent acetamidine is characterized byreveals

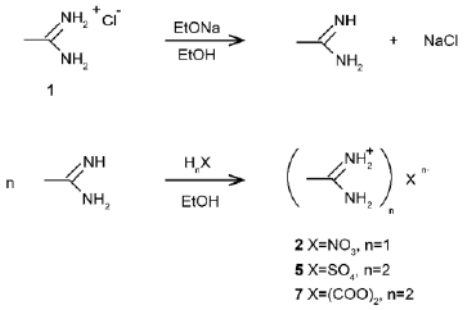

Fig. 4 Preparation of acetamidinium nitrate (**2**), sulfhate (**5**), and oxalate (**7**) from **1**.

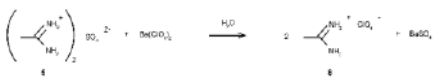

Fig. 3 Preparation of acetamidinium perchlorate (**8**) from **5** by ion exchange.

large cavities and an extensive networksystem of hydrogen bonding within itsthe structure. The distancess between the pivot carbon atom and the amino and amido nitrogen atoms are pivot carbon atom 1.344 Å and 1.298 Å, respectivelyand the amino and imido nitrogen atoms are rather distinct (1.344 Å for C-NH_2 and 1.298 Å for C = NH group).[24]

The hydrogen bridging observed in acetamidinium chloride (**1**),[26] acetamidinium sulfate (**5**),[18] and an one of the polymorphs of acetamidinium (2-hydroxyethoxy)acetate polymorph,[25] results in three-dimensional (acetamidinium chloride (**1**),[26] and acetamidinium sulphate (**5**)[18] revealed 3D) structures with large cavities. On the other hand, acetamidinium tetrazolate[27] and acetamidinium dinitromethanide (**6**)[19] showare two-dimensional (2D), the staircase-like 2D structures. Interesting examples are aAcetamidinium hexafluorosilicates, germanates, stannates, and titanates[28] are interesting examples of 2D structures. Other examples includeor the Re-Se cluster-acetamidinium adducts,[29] in whichwhere multicentreer NH...F or NH...Se contacts arewere found.

For two of the compounds studiedIn this study, we used XRD analysis to determine the molecularcrystal structures were determined by X-ray crystallography techniquesof several acetamidinium salts. Acetamidinium oxalate (**7**), shown in Figure Figure. 5)5,) hased a 2D structure withcomprising interconnected layers interconnected with not too extensivelimited H-bonding. In contrast, Aacetamidinium perchlorate (**8**, Figure Fig.ure 6)6) hased a 3D structure with layers that were interconnected withby extensive H-bonding.

The perchlorate and oxalate structures wereare rather unique in the set ofamong the acetamidinium structures determinedexamined. The molecular structure of the acetamidinium oxalate consists of is made up of two mutually similar acetamidinium units and one oxalate ion. All theseBoth ions participate inin both compounds are interconnected by extensive H- hydrogen bonding systems. In the oxalate (**7**, eEight- and fourteen-membered rings are formed by **7**, as shown in (Fig.ure (**7**). Acetamidinium perchlorate (**8**) Theprimarily forms rings with 22 members, as shown in are the main element of the perchlorate (**8**) structure (Fig.ure 8). In our analysis, the acetamidinium C-NH_2 group formed an H-bond with a single oxygen atom in perchlorate, and the distance between the pivot carbon atom and the NH_2 moiety, in this group was 1.323(3) Å. The other nitrogen-containing group formed two H-bonds with the perchlorate ion. The distance between the pivot carbon and nitrogen atoms in this group was the distances between the pivot carbon atom and the NH_2 moiety are rather different - 1.323(3) Å for the C-NH_2 group bonded by H-bonds only to one oxygen atom of the perchlorate ion, and 1.297(4) Å for the C-NH_2 group bonded by two H-bonds to the perchlorate ion. The molecular structure of the oxalate is made up of two mutually similar acetamidinium units and one oxalate ion. All these ions in both compounds are interconnected by extensive hydrogen bonding systems. In the oxalate (**7**), eight- and fourteen-membered rings are formed (Figure (**7**). The twenty two-membered rings are the main element of the perchlorate (**8**) structure (Figure 8).

In the oxalate structure, the distances between differences between the respective pivot carbon and nitrogen atoms werese groups are even greater at 1.339(5) Å and 1.280(5) Å. Our observations were not consistent, which disagree with a delocaliszation, and they differed from values concept and the data found in the literature, which fall between (1.302 and 1.312 Å). In these groupsreports, the H-bonds to the oxalate moiety are equidistant.

In light of the results of the XRD analysis, The molecular structure of the oxalate is made up of two mutually similar acetamidinium units and one oxalate ion. All these ions in both compounds are interconnected by extensive hydrogen bonding systems. In the oxalate (**7**), eight- and fourteen-membered rings are formed (Figure (**7**). The twenty two-membered rings are the main element of the perchlorate (**8**) structure (Figure 8).

From a study of the above mentioned data and motifs, in combination with the hygroscopicity data presented in Table 1 on the hygroscopicities of the compounds, it is clearly indicate that the 2D layered structures compounds containing with layered 2D (counterions linked by H-bridges) structures counterions linked by H-bridges—**2**, **4**, **6**, **7**, and **11**—were not hygroscopic.(**2, 4, 6, 7,** and **11:** for **7,** see Fig.ure 9) are not hygroscopic. illustrates the [ ] of **7**. On the other hand, the compounds that displayed 3D structures— (**1**, **3**, **5**, and **8**— were more hygroscopic. (for **8,** see Fig.ure 10 shows the [ ] for **8**.) have rather high hygroscopicities. This wasis probably due to

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Please review each statement and the revised statements for accuracy.

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caused by an easier incorporation of water molecules into the larger cavities ofin the compounds with 3D structures, compared to the intercalation of water into the compounds with 2D structures.

NMR spectroscopy

The NMR data for acetamidinium salts **2**, **4**, **7**, and **8** obtained with deuterated water (D_2O) are summarized in Table Table 2.2. A closer inspection of the proton NMR spectra measured in D_2O revealed that there is an equilibrium between deuterated and non-deuterated molecules, which were identified by marked (strongly decreased in the signal intensities of acidic protons intensity of the signals of the acidic protons). The equilibrium is shifted almost entirely to the side of the deuterated forms, indicating thatsample (approximately 98%) of the molecules were deuterated. These observations contradicted findingsre is a contradiction between these observations and those published by Kopylovich,[14] wherein which no deuteration was described, and two signals per 2H were observed.

On the other hand, the positidirection of the equilibrium wasis reversed in mixtures containing deuterated dimethyl sulfoxide (DMSO-d_6), in whichwhere approximately 90% of the compounds were in non-deuterated form can be found forin all of the samples measuredanalyzed. With the exception of acetamidinium formate (**4**)

In all cases (excluding 4 in in DMSO-d_6), two distinctseparated broadened signalspeaks belonging to the 2 × NHaHb arrangement were observed, which were probably due attributable to the delocalizsation of the positive charge throughout the amidinium group. The only exception is acetamidinium formate 4 in DMSO-d_6 whereproduced onea single broad signalpeak, which represented comprising all four NH protons bound to nitrogen was detected. The interactions within several acetamidinium complexes were studied by Tominey and Krechl using NMR, XRD analysis, and quantum chemical treatment.[17,27] Our NMR results wereThis is in accordance with the observations published by Krechl[17] and similar to the results obtained by Tominey[27] for acetamidinium tetrazolate complexes. These observations may have been due toThis may be caused by differences in the interactions between the formate anion and amidinium groups in deifferent solvents. The interactions inside some acetamidinium complexes were studied by Tominey and Krechl by means of NMR, X-ray analysis and quantum chemical treatment.[17,27]

Differential thermal analysis

Acetamidinium nitrate (**2**), acetamidinium dinitromethanide (**6**), and acetamidinium perchlorate (**8**) are energetic materials. The haveir potential for use is in pyrotechnic applications, where they may replace guanidinium nitrate or perchlorate salts (nitrate or perchlorate). The acetamidinium salts difference is the have a higher carbon contents than of acetamidinium salts compared to the their analogous guanidinium analogs, as ones (replacement of thean amino group in guanidines is replaced by a methyl group) in acetamidine. Nevertheless, acetamidinium salts still have a relatively high nitrogen content. Compounds **6** and **8** have exhibited acceptable decomposition temperatures as determined by differential thermal analysis (measured by differential thermal analysis (DTA)). The DTA thermograms from the compounds are shown in Fig. 11. Both the nitrate (**2**) and the perchlorate (**8**) decomposed upon melting. Thus, tThe decomposition temperatures of **2** and **8** wereare considered as being 183 °C and 248 °C, respectively. (Figure 11). The maxima of the decomposition ranges sfor **2** and **8** wereare 255 °C and 390 °C, respectively. ForIn comparison, decomposition of guanidinium nitrate on the same thermal stability device startedis to decompose at 270 °C, and guanidinium perchlorate started to decompose at 350 °C, using the same thermal stability device.

Conclusions

Acetamidinium salts were synthesized and characterized by elemental analysis, electrospray mass spectrometry, and NMR. The and, in the case of energetic salts were also examined bywith DTA. The structures of several previously unknown acetamidines have beenwere identified proved by X-ray diffraction by XRD analysis. Hygroscopicities of eight acetamidinium salts were determined at 90% humidity in 90% humidity of eight acetamidinium salts have been evaluated. The results of the different values of hygroscopicity analysis were are corroborated by the structuresal determinedations performed by XRD ray analysis. The acetamidinium salts with 2D layered structures wereare not hygroscopic, while the acetamidinium salts with 3D layered structures were highlyare quite hygroscopic.

Conflicts of interest

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Acknowledgements

The acknowledgements come at the end of an article after the conclusions and before the notes and references.

Notes and references

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"This is for interpretation of the key results and to highlight the novelty and significance of the work. The conclusions should not summarize information already present in the article or abstract. Plans for relevant future work can also be included."

I suggest replacing the summary of the analysis with a broader statement about the novelty of your findings and their importance to the field.

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  b. "The formation of the free base in methanol by the use of sodium methoxide produces sodium chloride" can be written as "The formation of the free base in methanol by using sodium methoxide produces sodium chloride"
- Incorrect word choice: Example: "list" is relevant when referring to a table (which contains values etc.). When referring to figures, "show," "display," and "demonstrate" are more suitable alternatives. Thus, the correct sentence would be "Here we describe the synthesis, crystal structure, hygroscopicity, and thermal stability of several of the acetamidine salts shown in Fig. 1." rather than "…listed in Fig. 1"
- Sentence construction: Sentences were revised to better convey your intended meaning. For example, "The difference is the higher carbon content of acetamidinium salts compared to the analogous guanidinium ones (replacement of the amino group in guanidines by a methylgroup)" was changed to "The acetamidinium salts have a higher carbon content than their guanidinium analogs, as an amino group in guanidine is replaced by a methyl group in acetamidine."

3. Does the edited paper adhere to the target journal's language preference?

The journal guidelines specify that standard British and American spellings are allowed, but they recommend being consistent in the choice of language preference. We have used American spelling, as per your preference. The journal also asks authors to keep the writing clear and concise, avoiding repetition or embellishment. The manuscript meets this requirement.

4. What types of changes were made for improvements to paper flow and how has the paper's readability improved because of these?

Abstract: Your abstract was clear and generally explained the study well. However, a few issues were noted. The families of compounds synthesized with acetamidines are detailed in the Introduction and need not be listed in the Abstract. Moreover, while elemental analysis and mass spectrometry are included here, there are no such results in the text. The significance of the study and the implications of its findings can be presented better in this section. As the abstract is well within the recommended word limit, I suggest briefly including some more details to highlight the significance of the study. For example, what advantages do acetamidinium salts with low hygroscopy offer to the field? What specific applications/fields could be benefited? How do the hygroscopic and thermal stabilities of the new salts compare to those of acetamidinium chloride?

Introduction: In the introduction, you have discussed the motivation for the study and highlighted the gap in knowledge that the study is trying to fill. The uses and limitations of acetamidinium salts have been described well in the background. However, it would be a good idea to talk about specific applications/fields that could benefit from these salts with altered hygroscopic properties to showcase the importance of the study and its potential impact. The paper currently does not have a Methods section. Please check with the journal on the need for a clearly defined Methods section. Several articles published in *Chemical Science* do not contain a materials and methods section. Rather, the experimental work is discussed more generally in the results and discussion section. Hence, I have retained your original style.

Results and Discussion: This section was generally concise and well-organized. The results were discussed well in reference to the illustrations and logical conclusions were drawn. The results were compared well with previous studies and there were no obvious inconsistencies. Some sentences were heavily revised to enhance clarity and readability. However, this section should highlight any limitations of the methods and study, including a discussion of potential sources of bias and imprecision associated with the results. This should be followed by some indication of the direction future research should take.

Conclusion: Overall, this section was clear and well-organized, and most revisions were focused on enhancing the formality and language. However, this section focuses more on a summary of the analysis and does not provide a clear explanation of the importance and relevance of the study to the field. You may wish to highlight the relevance and significance of the study to the field. For example, how is the development of these new salts expected to impact the field? What applications could benefit from these materials? Are there economic, environmental, or policy implications of these findings? Please elaborate on these aspects.

Section 2. MOCK EDITOR DESK CHECK

As part of the Mock Editor Desk Check service, the technical expert evaluates your manuscript content for readiness in terms of article structure, ethical-compliance-related aspects, and journal-specific requirements. This section of the report provides an overview of the potential gaps and focuses on improving the submission readiness of your manuscript by replicating the checks typically conducted by the journal's Editorial Desk.

Major issues likely to be raised by the journal's Editorial Desk and lead to rejection include:

1. Materials and methods should be added – this is a major gap
2. References should be added – this is a major gap
3. All figures and tables should be added along with their respective legends – this is a major gap
4. Other supporting information should be added (COI statement, corresponding author address, DAS, etc.)

Please revise your manuscript based on the comments in this section to ensure that your manuscript is submission ready.

2.1 Article Checks

PARAMETER	DESCRIPTION	RATING
1. Scope Match	Does the scope of the research presented in the manuscript match the scope of the target journal?	**EXCELLENT**
Notes: The manuscript meets the scope of the target journal Chemical Science.		
2. Article Type	Does the article type selected align with the structure presented in the manuscript?	**EXCELLENT**
Notes: This is an original research paper and is matched to the usual structure of this article type.		
3. Data & Methods	Has data collection been described in the Methods section (according to the article type) and presented appropriately via tables and figures in the Results section?	**POOR**
Notes: Methods have not been stated. Please include a detailed Materials and methods section; this section must include all materials (chemicals and other equipment used) and also thoroughly describe all methodology in the study (hygroscopicities, X-ray crystallography, NMR spectroscopy, differential thermal analysis).		
4. References	Is the cited literature relevant, selective, recent, and sufficient?	**POOR**
Notes: References are not provided. They are cited in the text, but the reference list is missing. Please provide all references cited in the text. Also, you should cite recent and relevant references, preferably in the last 5 years.		

2.2 Integrity Checks

PARAMETER	DESCRIPTION	RATING
1. Plagiarism Check	Is the Similarity Index score within acceptable limits for standard journal requirements (<15%)?	**EXCELLENT**
Notes: The manuscript shoes a 10% similarity score which is acceptable by most journal standards.		
2. Ethical Compliance	Have all necessary consents and approvals have been obtained from authors to publish their work (including IRB approval and Informed Consent, as needed)	Choose an item.
Notes: No ethical compliance is required for this manuscript.		
3. Data Availability Statement	Does the Data Availability Statement accurately describe the data and its presentation in the manuscript?	**POOR**
Notes: Data availability statement should be added at the end of the manuscript text. This is important, as a growing number of journals warrant availability of study data.		
4. Funding Information	Has funding information been provided, when needed, or a statement been made about it not being needed?	**POOR**
Notes: Funding information is not provided nor commented on. This is asked by most journals, so you will have to provide it, if applicable.		

2.3 Submission Checks

	PARAMETER	GAPS ANALYSIS	EXAMPLE/ISSUE
1.	**List of Contributing Authors**	Present	--
2.	**Author Contributions Statement**	Absent	Your target journal strongly encourages authors to include author contributions and recommend using CRediT for standardised contribution descriptions. Kindly refer to the author guidelines. Guidance on how to draft an author contribution statement here
3.	**Corresponding Author Email**	Absent	Please provide the corresponding author information in the title page. Guidance on the role of the corresponding author here
4.	**Conflict of Interest Statement**	Absent	Please provide a 'Conflict of Interest' statement at the end of the manuscript (e.g. funding, payments etc.) Guidance on how to include Conflict of Interest statements here
5.	**Figure & Table Citation**	Incomplete	Tables and figures have been cited in the text; however, they are missing from the manuscript. Please add all missing figures and tables.
6.	**List of Keywords**	NA	Your target journal does not require adding keywords.
7.	**Data Access Statement** This describes where the data associated with the paper is available, and under what conditions the data can be accessed.	Absent	Please add DAS as mentioned prior. *Chemical Science* strongly encourages authors to deposit as much data as possible in appropriate repositories. Please provide a data access statement at the end of the manuscript. Guidance on how to write a Data Access Statement here
8.	**Figure Legends**	Incomplete	Included, but incomplete. Guidance on how to write figure legends here
9.	**Table Legends**	Absent	Absent from the manuscript Guidance on how to write table legends here

Section 3. ARTWORK FORMATTING

We have formatted the figures in your manuscript according to the requirements of your target journal. This section of the report includes details of the revisions made and a glossary of terms.

3.1 Summary of Changes

The link to Artwork Guidelines for your target journal is https://www.rsc.org/journals-books-databases/author-and-reviewer-hub/authors-information/prepare-and-format/figures-graphics-images/

*3.1.1 Specifications of the final figures**

Figure #	Figure Type	Width (cm)	Height (cm)	Resolution (dpi)	File format	Font type	Color mode
Fig 1	[Line art]	8.3	2.5	1200	.eps/.pdf/.tif/.jpg	Arial	RGB
Fig 2	[Line art]	8.3	5.6	1200	.eps/.pdf/.tif/.jpg	Arial	RGB
Fig 3	[Line art]	17.1	2.5	1200	.eps/.pdf/.tif/.jpg	Arial	RGB
Fig 4	[Combination art]	8.3	5.3	600	.eps/.pdf/.tif/.jpg	Arial	RGB

*All changes/edits are made in Adobe Illustrator

3.1.2 Other changes

Figure number	Changes to figure	Changes to text
NA	NA	NA
NA	NA	NA

3.1.3 Issues

Figure number	Description of issue	Resolution
NA	NA	NA
NA	NA	NA

3.2 Glossary of terms

1. RGB (Red, Green, Blue): A color mode, usually recommended for images intended for online publication.
2. CMYK (Cyan, Magenta, Yellow, Black): A color mode, usually recommended for images intended for print publication.
3. TIFF (Tagged Image File Format): A file format, usually recommended for color and grayscale images, particularly photographs.
4. EPS (Encapsulated PostScript): A file format, usually recommended for images, particularly for vector images such as graphs.
5. Line art: Images with straight lines and text, such as graphs, charts, and simple diagrams
6. Halftone: Photographic images, drawings, paintings, etc. with fine shading
7. Combination art: Images that are a combination of halftone and line art or halftone and text.

Section 4. SUMMARY & NEXT STEPS

As part of this pack, we have completed the following services:

1. **Premium Editing**: Please go through the changes and comments in your edited manuscript in All Markup view (Review>>All Markup) and the input from the Editor under Section 2. Language Quality & Structure.
2. **Mock Editor Desk Check**: This report highlights information that would be needed for submitting your manuscript via a journal submission system. Please make sure that you include all suggested details in your manuscript.
3. **Artwork Formatting**: Please review the formatting changes that we have made to your figures to meet the journal's requirements.

Next steps for you

- Please revise your manuscript based on the recommendations in this report and comments in the manuscript.
- You can include any questions you have about specific comments within the manuscript as a response to the comments.

Once the revisions are complete, the **Editor** will review the changes you have made and provide additional comments (if needed). We will also respond to any queries you may have during this process.

We would also like to know what you think of our work and how we can do better. Please share your feedback on the assignment through your EditageOnline™ account. Thank you, once again, for giving us the opportunity to partner with you on your publication journey!

Best regards,
Editage

Acknowledging editing support
Several authors choose to acknowledge Editage's editorial support in their paper. According to prominent publication guidelines such as the ICMJE guidelines on authorship, editing or writing support should be acknowledged in the paper. Such acknowledgments also serve to assure journal editors/reviewers that the English has been thoroughly reviewed and meets the required standards for publication.

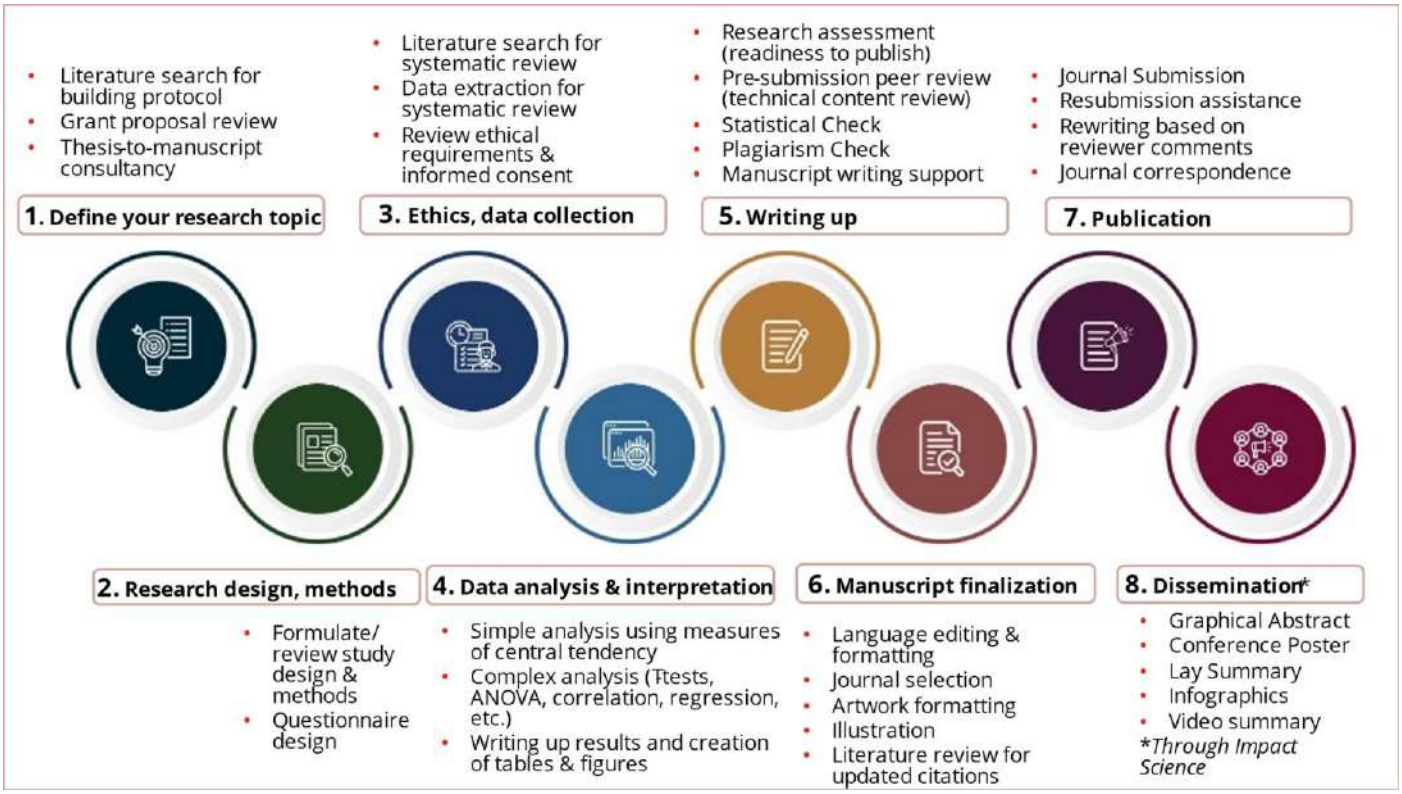
If you would like to acknowledge our editorial support for this paper, you can do so by including the following sentence in the Acknowledgments section of your paper:

We would like to thank Editage (www.editage.com) for English language editing.

Appendix

a. Other Service Recommendations

Depending on the stage of your research/writing, there are a host of services that we offer (below). More details about some packs/services are provided later.



Revising your manuscript based on expert comments

If you are finding it challenging to revise your manuscript based on suggestions from the technical reviewer and the editor, the **REWRITING ASSIST*** service can support you.

- Under this service, the **Editage Scientific Writer** will make revisions to the sections of the manuscript highlighted during the technical review, while seeking clarification from you on intellectual content.
- We will finalize the manuscript content over 2 rounds and ensure that there are no gaps in technical content, logic, or flow of the manuscript, making it ready for submission.

Not available for authors in **China and **Korea***

Statistical support

We provide a wide variety of statistical support services, depending on the stage of your research and your need:

- **STATISTICAL CHECK:** If you have already performed the statistical analysis and need an expert to check accuracy of results and appropriateness of reporting results, you can use this service. Our expert statisticians will check your data analysis and provide actionable feedback to eliminate any issues.
- **STATISTICAL ANALYSIS:** If you have collected data and decided on the methods and tests to analyze it, we can support you with simple or complex statistical analysis.

Insufficient/out-of-date citations

You can consider using our **LITERATURE REVIEW** service, where a subject area expert will review the source files or draft manuscript and perform a literature search to provide appropriate and recent reference citations for factual information and comparisons of results. Through this service, the subject area expert will prepare a report that will:

- Examine current knowledge in the area of research to help authors highlight the relevance of their study in this context.
- Evaluate the literature sources and advise on the most pertinent or relevant literature (which authors may use as citations in their manuscript).
- Highlight arguments and ideas of other published work as relevant to the authors' study for them to use in their Introduction/Discussion/Conclusions sections (based on abstract or full article).
- We will provide between 10-15 relevant references that can be used by the authors as citations or to improve their manuscript.

Please get in touch with us if you would like more information about any of these services or have any other requests for improving your manuscript. You can choose to use any of these services individually or combine one or more components, based on your need. We will be happy to customize a pack that is suited exactly to your requirements!

(Please note that choosing any additional service is optional and at your discretion).

b. Frequently Asked Questions

Q: Who reviews my manuscript? What is the experts' qualification?
A: Our technical reviewers have a minimum qualification of a PhD in your relevant subject area and have extensive experience in publishing and peer-reviewing manuscripts. These experts also have experience of writing and publishing their own manuscripts in peer-reviewed journals. Many of our experts even serve as peer reviewers on journal editorial boards.

Q: Do I have to make ALL the changes suggested by the technical reviewer in the report and the manuscript?
A: We highly recommend that you review and address all the focus areas and recommendations for improvements that we have suggested. These will help with improving the scientific rigor of your manuscript.

Q: I do not fully understand / agree with some of the reviewer comments
A: Please respond in the 'comments' box with your queries about focus areas or recommendations for improvement. The reviewer will respond to these in the free round of review after you have addressed all requests for changes/revisions.

Q: Will you make revisions / correct the areas flagged by your reviewers?
A: No, we will not make any changes to the manuscript. We will provide suggestions for improvement of your manuscript by highlighting gaps in scientific content (similar to a journal peer reviewer). We will review the changes you have made and give you further comments, as needed.

If you are based in Japan, we will be happy to make revisions for you (at an additional cost). You will be required to provide us the factual information necessary to make revisions.

Q: Do you guarantee publication?
A: Publication depends largely on the quality of your research and is a subjective decision that the journal editor takes based on several factors. Therefore, we cannot guarantee publication. However, by helping you understand and follow publication protocols, and by improving the technical content and presentation of your manuscript through services like the Rapid Technical Review and Premium Editing service, we help you increase your chances of publication.

Q: Is there post service support?
A: You can make revisions and send the manuscript back to us for review by the language editor. A review of changes to the scientific content by the technical expert is chargeable. Please let us know if you would like to use this service. Please make ALL revisions possible before sending back the manuscript, so that the review will be more effective.

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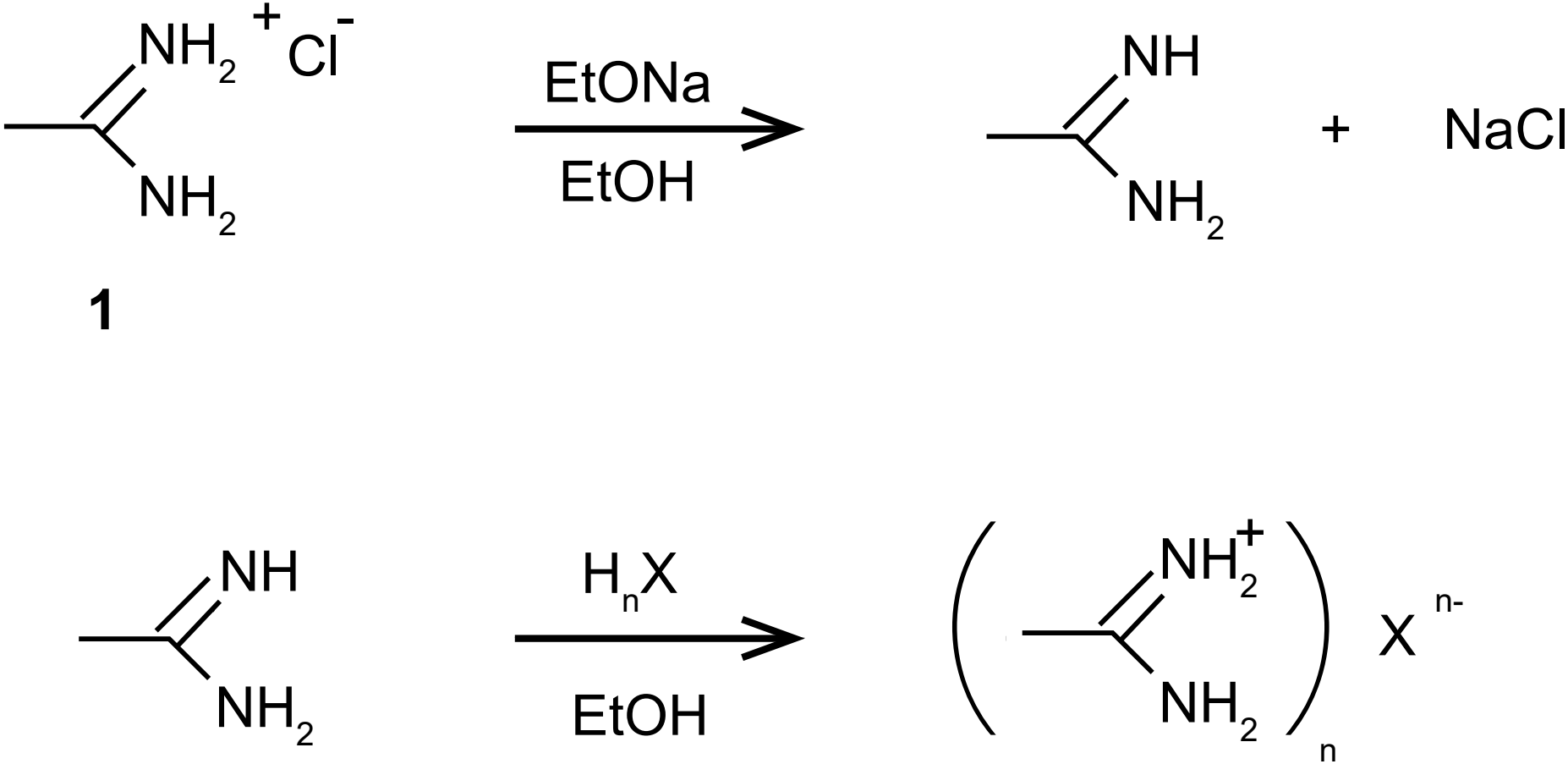
810,000+ clients served

2 million+ projects delivered

editage Researcher.Life CACTUS LIFE SCIENCES IMPACT SCIENCE Mind the GRAPH Paperpal

5 **8**


NH2
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NH2
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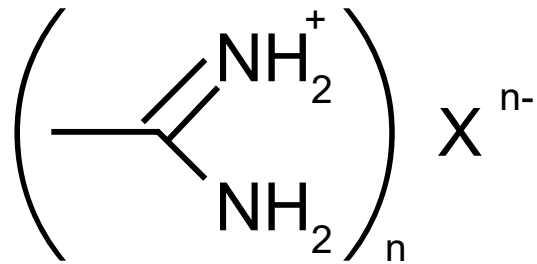
7 X=(COO)2, n=2



1 X=Cl, n=1

2 X=NO_3, n=1

3 X=CH_3COO, n=1

4 X=HCOO, n=1

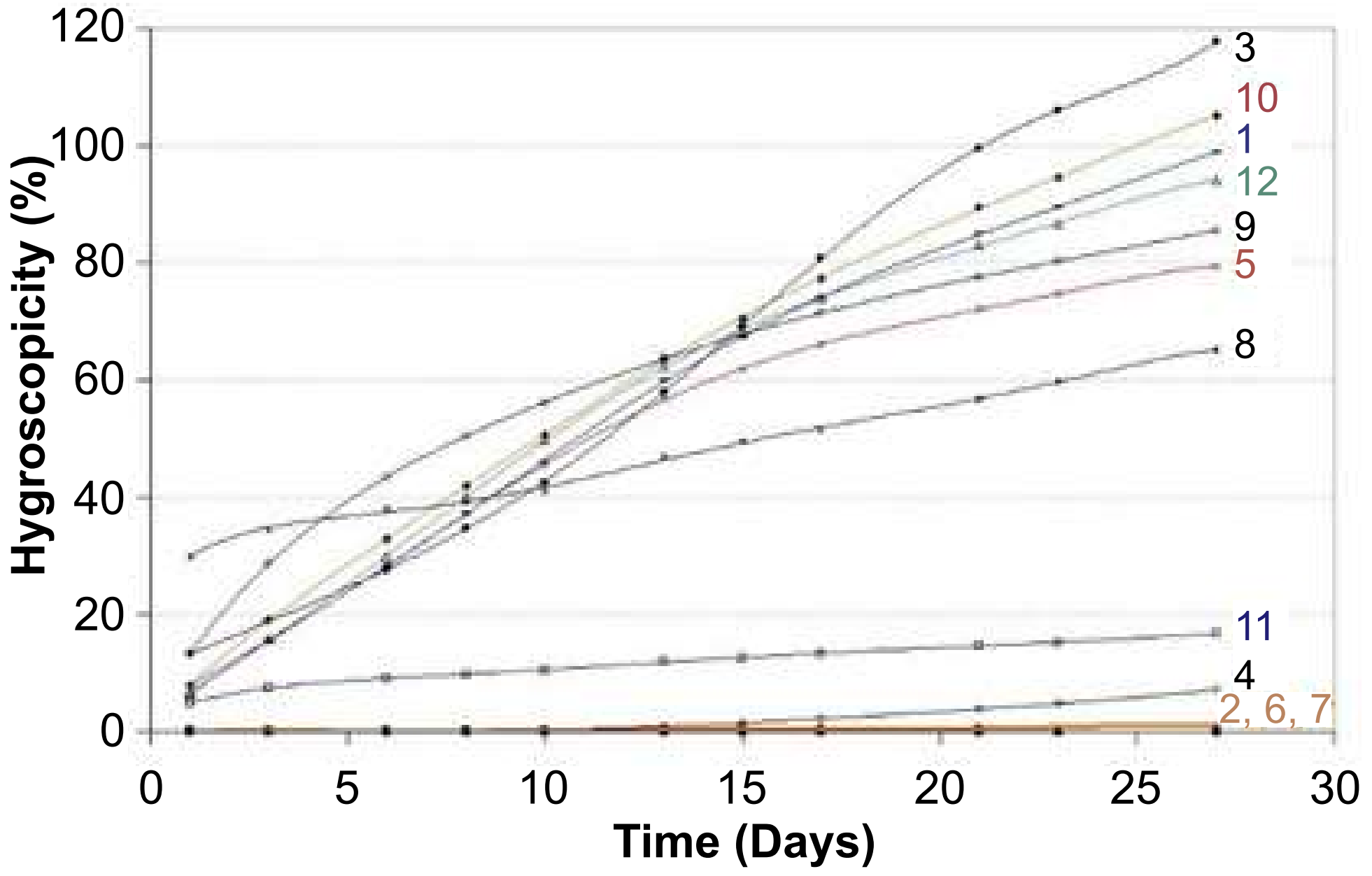
5 X=SO_4, n=2

6 X=$CH(NO_2)_2$, n=1

7 X=$(COO)_2$, n=2

8 X=ClO_4, n=1

9 X=HSO_4, n=1


Hygroscopicity (%)
120
100
80
60
40
20
0
0
5
10
15
20
25
30
Time (Days)
3
10
1
12
9
5
8
11
4
2, 6, 7

[Date of submission]

Andrew Cooper
Editor-in-chief
Chemical Science

Dear Dr. Cooper:

I wish to submit an article for publication in *Chemical Science*, titled "**Synthesis and properties of novel acetamidinium salts**." The paper was coauthored by Robert Matyáš, Jan Ottis, Aleš Růžička, Petr Šimůnek, and Miroslav Polášek.

In this study, we synthesized and characterized several novel acetamidinium salts that may serve as possible replacements for acetamidinium chloride. We believe our study makes a significant contribution to the literature because acetamidinium chloride is currently one of the only commercially available acetamidinium salts, and its highly hygroscopic nature makes it difficult to use. Replacing it with less hygroscopic acetamidinium salts will facilitate synthesis of a variety of important chemicals, including biochemically active and highly energetic compounds.

Further, we believe this paper will be of interest to the readership of your journal, because access to a wider variety of acetamidinium salts may reduce the cost of manufacturing many chemicals.

This manuscript has not been published or presented elsewhere in part or in entirety and is not under consideration by another journal. We have read and understood your journal's policies, and we believe that neither the manuscript nor the study violates any of these. There are no conflicts of interest to declare.

Thank you for your consideration. I look forward to hearing from you.

Sincerely,

Zdeněk Jalový
Faculty of Chemical Technology
Institute of Energetic Materials
University of Pardubice
Studentská 95, CZ-532 10
Pardubice, Czech Republic
[Phone number]
[Fax number]
[Email address]

Commented [A1]: Please insert date of submission here.

Commented [A2]: Please note, a list of preferred referees is to be entered in the manuscript submission system only. They should not be included in the cover letter.

Commented [A3]: I have written this paragraph assuming that the information presented herein is true. If this is not the case, please reword this paragraph as you deem fit**.**

Commented [A4]: If conflicts of interest need to be declared separately, replace this sentence with the following one: "Details about competing interests are provided separately."

Commented [A5]: Please add the phone number, fax number, and email address of the corresponding author here.