

## ***Inocybe* poisoning from Kerala-a case study**

---

**C. BIJEESH, C.K. PRADEEP\* AND K.B. VRINDA**

Jawaharlal Nehru Tropical Botanic Garden and Research Institute,  
Palode, Thiruvananthapuram 695 562, Kerala

---

Received : 06.12.2019

Accepted : 11.12.2019

Published : 27.01.2020

---

Cases of poisoning by *Inocybe carnosibulbosa* is reported from the State of Kerala. A morphological description of the material causing the poisoning is provided and the associated case history is detailed.

**Key words:** Agaricales, mycetismus, systematics

---

### **INTRODUCTION**

The incidence of mushroom poisoning varies a lot over the world depending on local traditions, life-styles, nutritional factors, climatic conditions and the occurrence of wild mushrooms. Disregarding mushrooms containing psychoactive toxins, ingestion of toxic fungi is almost invariably accidental. At present mushroom poisoning is quite common in Kerala and *Chlorophyllum molybdites* (G. Mey.) Masee, is reported to be the frequent cause of mycetism in Kerala (Bijeesh *et al.* 2017). Almost all species of the genus *Inocybe* are poisonous and contain 'muscarine' which is one of those toxins that is not usually regarded as 'deadly'. Muscarine was first discovered in *Amanita muscaria* but the toxin is present at very low levels in *Amanita muscaria*, however, it is known to occur at much higher levels in other mushrooms and is particularly high in a number of species of the genus *Inocybe* (even up to 100 times). The symptoms of muscarine poisoning are: a dramatic increase in salivation, lacrimation and perspiration accompanied by vomiting, diarrhea and stomach pain. Death rarely occurs with this type of poisoning but on rare occasions, muscarine poisoning can be fatal and this is often explained on the basis that the person had some other debilitating disease. Moreover if taken along with alcohol or other drugs it may be fatal. After

treatment, the patient will make a 100% recovery with no lasting ill effects or damage to the vital organs like liver, kidney etc. (Lurie *et al.* 2009). As with any kind of poisoning, the two most important things to do are to seek immediate medical attention and identify the agent responsible.

### **MATERIALS AND METHODS**

Based on reports on wild mushroom poisoning in all the leading dailies of Kerala, the mushroom research team of JNTBGRI visited the Medical College Hospital at Thiruvananthapuram and collected as many details as possible from the hospital by examining the files of wild mushroom poisoning patients who were admitted to the Medical College Hospital, Thiruvananthapuram, and interviewing the victims of poisoning and the wayside seller. Mushroom specimens responsible for the poisoning were immediately collected from the same localities from where the victims had collected them. Collected specimens were systematically analyzed and identified following standard taxonomic methodology (Singer, 1986). Microscopic examination of tissues was made from thin free-hand sections revived in 3% aqueous KOH and stained in 1% Congo red. Examinations were made directly using a Leica DME 1000 research microscope. Basidiospores were examined in Melzer's reagent or 3% aqueous KOH. Spore measurements were taken from hymenial tissues and 30 basidiospores from

---

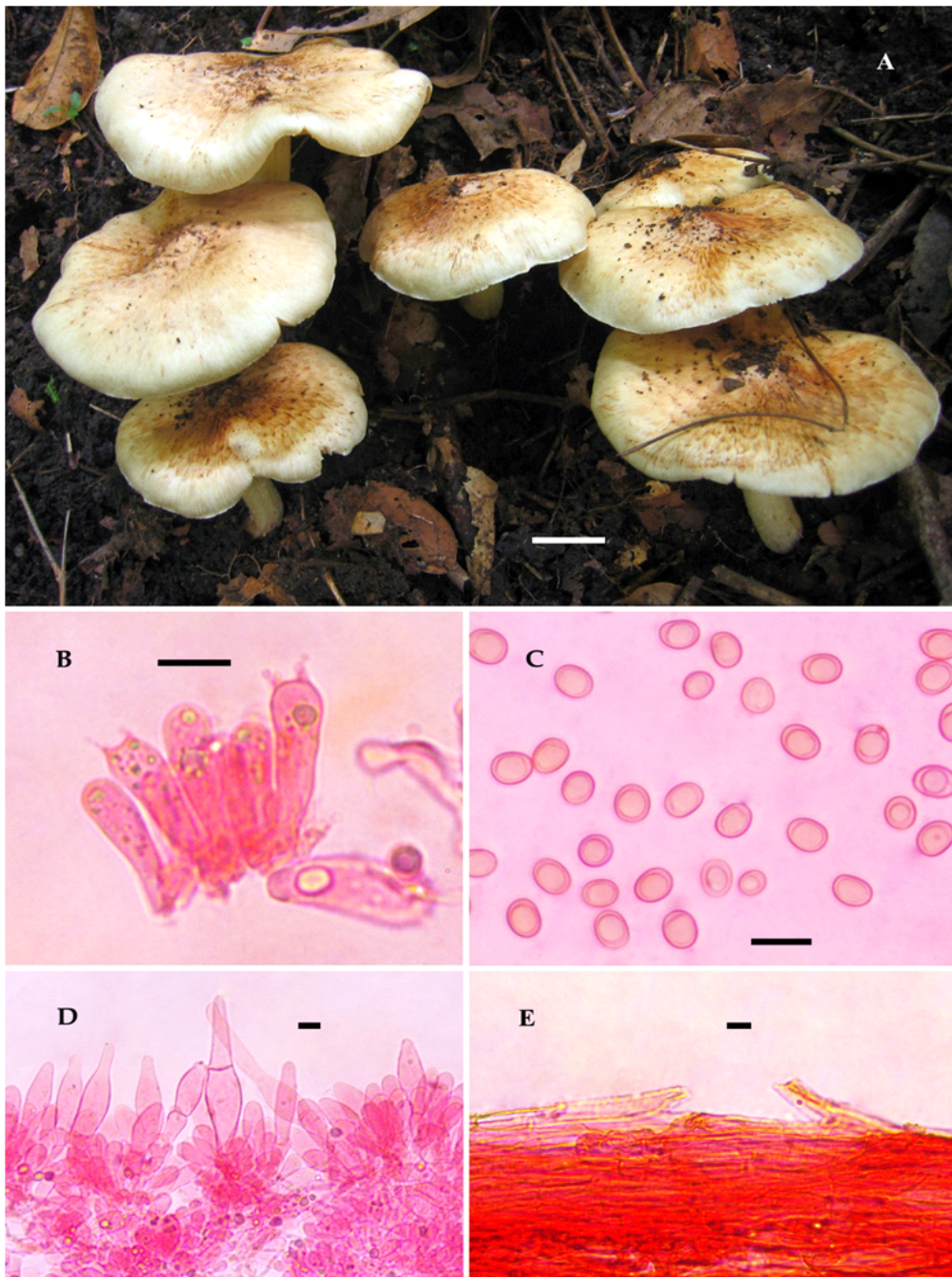
\*Corresponding author : ckpradeep@intbgri.res.in

sections were measured. Colour codes and notations are from Kornerup and Wanscher (1978). All the collections examined are deposited at the Mycological Herbarium of TBGRI [TBGT (M)].

## RESULTS AND DISCUSSION

*Inocybe carnosibulbosa* C.K. Pradeep and Matheny, *Mycol. Progr.* 15 (24): 16 (2016).

*Pileus* 4.5–10.5 cm wide, convex when young, becoming plano-convex to applanate with a broad obtuse umbo or with a slightly depressed centre, becoming a little uplifted with age; uniformly yellowish white to cream (3A2/4A3) when young, becoming more brownish at the disc (6C3/6C4/6D4/6E5/6E6) and cream to yellowish white (4A2/4A3) elsewhere, smooth at the disc, appressed fibrillose-striate elsewhere, appearing squamulose when dry, rimose, often splitting radially exposing the underlying white context below, dry; margin



**Fig. 1.** *Inocybe carnosibulbosa*. A. Habit *in situ*; B. Basidia; C. Basidiospores; D. Cheilocystidia; E. Pileipellis. Scale bar: A = 20mm, B-E = 10  $\mu$ m.

incurved when young becoming straight, entire to incised. *Lamellae* adnexed, white to yellowish white when young, becoming brownish orange (5C3/5C4) with age, up to 1.4 cm wide, crowded, with lamellulae of different lengths; edge paler, entire. *Stipe* 5–12 × 0.7–1.7 cm, central, cylindric, with or without a marginate basal bulb, tapering abruptly below, white to yellowish white (5A2/5A3), becoming brownish (6C4/6D4/6F4) on handling, fibrillose striate. *Context* solid, white, soft, up to 0.8 cm wide. Odour mild. *Spore print* snuff brown. *Basidiospores* (5.5–) 6–8 × 5–6.5 [ $7.2 \pm 0.66 \times 5.4 \pm 0.30$ ]  $\mu\text{m}$ ,  $Q = 1.07\text{--}1.42$ ,  $Q' = 1.26$ , smooth, subglobose to broadly ellipsoid, rarely phaseoliform, yellowish brown, thick-walled. *Basidia* 27–31 × 7–8  $\mu\text{m}$ , clavate, 4-spored, thin-walled, hyaline. Lamella-edge sterile with tufts of cheilocystidia. *Cheilocystidia* 29–140 × 6–13  $\mu\text{m}$ , clavate, vesiculose, lageniform with a long narrow neck, multi-septate, thin-walled, hyaline. *Pleurocystidia* absent. *Hymenophoral* trama regular, composed of thin-walled, hyaline hyphae, 5.5–14  $\mu\text{m}$  wide. *Subhymenium* pseudoparenchymatous, 2–3 cells thick. *Pileal trama* composed of loosely arranged hyphae, 2.5–12.5  $\mu\text{m}$  wide, inflated up to 22  $\mu\text{m}$  wide, thin-walled, hyaline. *Pileipellis* an interrupted epicutis, consisting of parallel 3–5  $\mu\text{m}$  wide, incrusting hyphae, with yellowish brown contents. *Stipitipellis* a cutis of parallel, thin-walled, hyaline hyphae, 2.5–5  $\mu\text{m}$  wide, incrusting at places. *Stipe trama* with parallel arranged, thin-walled, hyaline, 7.5–22  $\mu\text{m}$  wide hyphae. *Caulocystidia* absent. Clamp connections present in all tissues.

### **Habitat and phenology**

Scattered, in groups or in pairs, on forest floor, under *Hopea parviflora* Bedd. (Dipterocarpaceae) and *Xanthophyllum* sp. (Polygalaceae). July–November.

### **Specimens examined**

India, Kerala State, Thiruvananthapuram district: Palode, 20 July 2015, TBGT (M) 15769.

### **Additional specimens examined**

India, Kerala State, Thiruvananthapuram district: JNTBGR campus, 25 September 2008, TBGT(M) 12047; 20 November 2008, TBGT(M) 12276; 14 October 2009, TBGT(M) 12976; 23 October 2009,

TBGT(M) 13011; 16 November 2011, TBGT(M) 13898; 17 November 2011, TBGT(M) 13906; 18 November 2011, TBGT(M) 13909; 30 September 2015, TBGT(M) 15878; 07 November 2016, TBGT(M) 16681; 01 August 2018, TBGT(M) 17616.

The species is so far known only from the type locality.

The genus *Inocybe* (Fr.) Fr., was originally placed in the family Cortinariaceae Heim ex Pouzar. Later, phylogenetic analyses, suggested that the genus was better placed as the type genus of the family Inocybaceae Jülich, as Cortinariaceae was not a monophyletic group. Most Inocybaceae members can be recognized in the field by a combination of features of their fruit bodies, which are typically brown in colour, small to medium sized with a stipe, a fibrillose to scaly pileus, brownish attached lamellae with whitish fimbriate edges and dull brown spore deposit (Matheny and Bougher, 2017).

*Inocybe carnosibulbosa* C.K. Pradeep & Matheny, was originally described from Kerala (Pradeep *et al.* 2016). The species is characterized by its large, fleshy tricholomatoid basidiomes, cream to yellowish white pileus with a brownish disc, small subglobose, smooth basidiospores, conspicuous cheilocystidia with a long neck and association with indigenous trees like *Xanthophyllum* and *Hopea*. *Inocybe virosa* C.K. Pradeep, K.B. Vrinda & Matheny, another species described from Kerala is a poisonous look-alike (Pradeep *et al.* 2016) of *I. carnosibulbosa*. Though both the species cannot be readily distinguished based on morphological characters, microscopically they are distinct by virtue of the size and shape of their cheilocystidia. *Inocybe virosa* has comparatively smaller cystidia which are clavate to inflated clavate, where as in *I. carnosibulbosa* they are large and conspicuous, often with a long narrow neck.

*Inocybe cutifracta* Petch, described from Sri Lanka, is another closely related species, with a similar morphology, differing in the smaller size of the basidiomata, larger basidiospores [ $7\text{--}11 \times 4.5\text{--}6$  ( $8 \pm 0.5 \times 4.8 \pm 0.3$ )  $\mu\text{m}$ ,  $Q = 1.6$ ], and cheilocystidia with a globose capitellum.

*Inocybe gregaria* K.P.D. Latha & Manim., yet another species described from Kerala (Latha and Manimohan 2016) also shows some affinity to *I.*

*carosibulbosa* in its general morphology but the former can be separated macroscopically by the presence of occasionally bifurcated lamellae and pruinose stipe apex and microscopically by the presence of caulocystidia.

### Reports of mushroom poisoning cases

On July 19, 2015, two poisoning cases occurred in Thiruvananthapuram district due to the consumption of mushrooms collected from a rural property at Palode by a tribal wayside seller. Eleven people belonging to two different families were the victims, including a lactating mother (who had consumed the mushrooms) and her six month old baby, feeding her mother's breast milk. All of them were admitted to the Medical College Hospital, Thiruvananthapuram, due to heavy perspiration, salivation, vomiting, giddiness, diarrhea, headache, anxiety and disturbances of vision. In both the cases, the same mushroom species was involved as both the families had purchased the mushrooms from the same tribal wayside seller. After supportive treatment involving intravenous normal saline, antiemetic and intravenous atropine, all the patients made a full clinical and laboratory recovery within 12 hours. They were kept in observation for another 12 hours and were discharged from the hospital afterwards. The severity of the toxic effects seemed to be related to the amount of mushroom consumed; however, this could not be accurately determined. All patients recovered with supportive treatment, and low-dose atropine was required in five patients. A cat and a chicken also died after eating the mushrooms raw. These poisoning cases were reported by all the newspapers of Kerala with great significance. Based on the reports, the Mushroom Research team of JNTBGRI made a thorough investigation about these cases. The site was visited, met the victims and collected the leftover mushroom samples they consumed. A critical study of the specimens in the laboratory revealed that the mushroom was a hitherto undescribed species, belonging to the genus *Inocybe*, a member of the family Inocybaceae. The species was described and later published as *Inocybe carosibulbosa*, in reference to the large fleshy basidiomes with a pronounced bulbous stipe base (Pradeep *et al.* 2016).

The symptoms mentioned in the above case history, particularly the intensive vomiting, nausea, diarrhea, abdominal pain, hyper salivation, blurred

vision, chills, headache, and anxiety and the moment of their appearance, rather soon after the ingestion, are typical muscarine poisoning syndromes. Many species of the genus *Inocybe* are muscarine-containing mycorrhizal mushrooms, ubiquitous around the world. Presence of muscarine in relatively high concentrations in many species of *Inocybe* were also recorded.

Species of *Inocybe* are quite common in the forests of Kerala and the scientists of JNTBGRI have already documented 17 species from the State, none being edible. All the species appear in large numbers, forming ectomycorrhizal association with indigenous tree species like *Hopea parviflora*, *Vateria indica* (Dipterocarpaceae), *Aporosa acuminata* (Phyllanthaceae), *Knema attenuata* (Myristicaceae), *Calophyllum* (Calophyllaceae) and *Xanthophyllum* (Polygalaceae). Members of the genus *Inocybe* are quite distinct in appearance and do not resemble any of the common edible species in Kerala.

### ACKNOWLEDGEMENTS

The authors are very grateful to the victims of the poisoning in Thiruvananthapuram, Kerala and authorities of the Medical College, Thiruvananthapuram, for their kind collaboration and willingness to supply us with all the necessary details. Bijeesh acknowledge financial support from UGC as Rajiv Gandhi National Fellowship.

### REFERENCES

- Bijeesh, C. Vrinda, K.B. and Pradeep, C.K. 2017, Mushroom poisoning by *Chlorophyllum molybdites* in Kerala. *J. Mycopathol. Res.* **54**: 477–483.
- Kornerup, A. and Wanscher, J.H. 1978, *Methuen handbook of colour*, Ed. 3. Eyre Methuen, London. 252 pp.
- Latha, K.P.D. and Manimohan, P. 2016, *Inocybe gregaria*, a new species of the Inosperma clade from tropical India. *Phytotaxa*, **286**: 107–115.
- Lurie, Y. Wasser, S.P. Taha, M. Shehade, H. Nijim. J. Hoffmann, Y. Basis, F. Vardi, M. Lavon, O. Suaed, S. Bisharat, B. and Bentur, Y. 2009. Mushroom poisoning from species of genus *Inocybe* (fiber head mushroom): a case series with exact species identification. *Clin. Toxicol.* **47**: 562–565.
- Matheny, P.B. and Bougher, N.L. 2017. *Fungi of Australia: Inocybaceae*. *ABRS*, Canberra; CSIRO Publishing, Melbourne 582 pp.
- Pradeep, C.K. Vrinda, K.B. Varghese, S.P. Korotkin, H.B. Matheny, P.B. 2016, New and noteworthy species of *Inocybe* (Agaricales) from tropical India. *Mycol. Prog.* **15**: 24.
- Singer, R. 1986, *The Agaricales in modern taxonomy*, 3rd Edn. Verlag J. Cramer, Vaduz 912 pp.

## INSTRUCTION FOR CONTRIBUTOR TO JOURNAL OF MYCOPATHOLOGICAL RESEARCH

### 1. SCOPE OF THE JOURNAL

*Journal of Mycopathological Research* is an international journal open to contributions of merit dealing with all aspects of basic and experimental mycology, plant pathology, virology, bacteriology and other allied disciplines. Each manuscript submitted to *Journal of Mycopathological Research* must be an original research report that has not been submitted or published elsewhere either as a part or full.

Two types of manuscripts can be submitted to *Journal of Mycopathological Research* for publication: full-length articles and short communications.

**Full-length articles**: Manuscripts should be of a length of 3-10 pages (A-4 size) generally and the length of the paper should be consistent with the extent and scope of the data presented in the manuscripts.

**Short communications**: Manuscripts should not be more than 3 pages (A-4 size) in length and it must represent either a preliminary report or a complete data of an important research contribution.

Wherever a new genus or species of pathogen is being reported, the authority for identification and the IMI, HCIO, ITCC, etc for the type collection should be indicated. The report should be appropriately supported by tables, figures and references as required.

Besides these two types of manuscripts, the Editor may consider for publication of **Review articles** on any of the above disciplines.

### 2. SUBMISSION OF MANUSCRIPT

Authors should submit their articles to the *Journal of Mycopathological Research* online to facilitate quicker and more efficient processing. Electronic submission substantially reduces the editorial processing and reviewing time and shortens overall publication time.

For online submission of manuscript please log in directly to the site [www.imskolkata.org](http://www.imskolkata.org) and upload your manuscript following on screen instructions. In case of problems during the submission process please contact us through email (**ims.kolkata@yahoo.com**)

**No manuscript will be received by hand/post/e-mail.**

### 3. PREPARATION OF MANUSCRIPT

Submit manuscript prepared in the following order:

**1 : Name, address, telephone, e-mail and fax number of author to whom all correspondence should be sent. 2 : Title of article, author(s), full name(s)**

**institution address (es) with pin code. 3 : Abstract and Key words. 4 : Introduction, Materials and Methods, Results and Discussion, Acknowledgement(s) and References. 5. Table(s), 6. Figure(s) and Photograph(s)**

### 4. FORMAT

**Title**: The title should clearly indicate the important aspects of the article and preferably in not more than 100 characters and space.

**Abstract**: Limit abstract to one paragraph of 200 words.

**Key words**: List in alphabetic order the words or phrase that are not in the title and abstract.

**Introduction**: Give a concise account of the previous works done indicating clearly the importance of the works tackled in the present case. Point out clearly the existing problems and mention whether all the problems have been tackled or not. If not the reasons may also be stated.

**Text**: After the **introductory statement the rest of the material should be presented in Materials and Methods, Results and Discussion, Acknowledgement, and References.** Further subheading may be used, if very much necessary, but excessive fragmentation of the text should always be avoided.

In measurement SI units should be used. Numericals should be used before standard units of measurement.

Commonly used symbols and abbreviations should be used.

Latin binomials should be underlined and include citation of authors in all cases at the first introduction in the text.

In all cases, indicate the source of cultures and mention the designation of cultures obtained from or deposited in a recognised collection centres, national or international. In all cases the voucher culture or specimen(s) should be deposited in a national or international collection centre and to mention the same in the text with the deposit number of the said institute.

The term cultivar should be mentioned for agronomic and horticultural varieties of the crop and the complete source of the cultivar should be clearly mentioned in the text.

All the experimental results should be presented with

statistical analysis. The statistical methods should be described in detail.

**Figures and Photographs :** Each figure should be labelled with the figure number, Captions should be clearly described so that the figure is intelligible individually. Photographs either black and white/ colour should be clear and labelled with number.

**Tables :** Each table should be labelled with table number. The title and legends of the tables should be self-explanatory so that each table is intelligible.

**References :** References should be given in alphabetical order of the surname of the author. Name of the journal, books, monograph and thesis should be underlined or italic typed. Volume number to be double underlined or bold type and starting and ending page numbers are to be given.

**Reference cited older than 10 years are not encouraged.**

Jadaik, CV.L. and Kapoor, J.N. 1975, Cultural studied on some edible fungi. *Ind. Jour. Mushroom.* 1: 23-29.

**Online citation including URL or DOI**

Anderson, F.T. 1951. *Techniques for the preservation of three dimensional structure in preparing specimens for the electron microscope.* Transactions of the New York Academy of Sciences. Doi : 10. 1111/Ij. 2164-0947. 1951. tbo1007.x

Arorymous, 2015. Statistical database. [www.fao.org](http://www.fao.org)

Please go through the latest issue of the journal.

## 5. COPYRIGHT

Authors submitting a manuscript for publication in the *Journal of Mycopathological Research* do so on the condition that, if it is accepted for publication, copyright in the article shall be assigned exclusively to the Publisher including the right to reproduce the article in all forms and media.

The Publisher will not impose any restriction on the author for using the published article for his/her own personal uses.

## 6. OFFPRINTS

Because of the high cost of publishing, no offprints are given to author. However, offprints will be made available on payment of extra charges and the same must be informed to the Editor during returning the galley proof along with the charges in demand draft on line.

## 7. REVIEW OF MANUSCRIPTS

Each manuscript will be reviewed by two independent referees. Each referee will send his specific recommendations to the Editor of journal . If there is disagreement in the recommendation of the referees, the Editor may send the paper to third referee. Finally, the Editor is responsible for judging the suitability of manuscripts for publication in journal.

**Submit the revised manuscript online :** Please upload corrected manuscript point-by-point to the comments made by the referees/reviewers/Editor along with the original manuscript.

**After receiving the revised manuscript :** Acceptance of the article will be sent with processing charge. Processing charge is fixed as per number of printed pages. **Separate processing charge is fixed for colour figure. Corresponding author will be responsible for paying the processing charge in full. Processing charge must be paid within 15 days of receiving acceptance, otherwise publication will be delayed.**

### Symbols and abbreviations commonly used in *Journal of Mycopathological Research*

<i>Prefixes to the Units of Volume names of units</i>		<i>Units of time</i>	
Kilo (10 <sup>3</sup> )	K	second	sec
Deca (10 <sup>2</sup> )	D	hour	hr
Mega (10 <sup>6</sup> )	M	day	day
Giga (10 <sup>9</sup> )	G	month	month
Tera (10 <sup>12</sup> )	T	year	yr
deci (10 <sup>-1</sup> )	d		
centi (10 <sup>-2</sup> )	c		
mili (10 <sup>-3</sup> )	m		
micro (10 <sup>-6</sup> )	μ		
nano (10 <sup>-9</sup> )	n		
pico (10 <sup>-12</sup> )	p		
femto (10 <sup>-15</sup> )	f		
atto (10 <sup>-18</sup> )	a		
liter	l		
milliliter	ml		
microlitre	μl		
<b>Units of mass</b>		<b>Units of concentration</b>	
Kilogram	kg	Molar	M
gram	g	millimolar	mM
milligram	mg	micromolar	μM
microgram	μg		
		<b>Units of length</b>	
		meter	m
		centimeter	cm
		millimeter	mm
		micrometer	μm
		nanometer	nm
		Angstrom (0.1)	Å
		<b>Unit of temperature</b>	
		Kelvin	K
		Celsius	°C