

A COMPLEMENT FOR THE WHO LABORATORY MANUAL FOR THE EXAMINATION AND PROCESSING OF HUMAN SEMEN (FIRST EDITION, 2010)

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The WHO “Laboratory manual for the Examination and processing of human semen” is a reference guide, firstly published in 1980, to standardize the procedures for the examination of human semen. It has been updated three times; the last version was published in 2010 (1) It provided guidance about many aspect of semen examination like: semen collection, macroscopic and microscopic examinations, immunological properties, microbiological properties and biochemical properties of seminal plasma. Semen examination is the first laboratory test to study the physio-pathological testicular function in adults and it may also be useful for investigating male fertility status as well as monitoring spermatogenesis during and following male fertility regulation.

The aim of this work is trying to standardize the way of describing in clinical laboratory reports the properties related to semen examination.

The systematic syntax described here is the one recommended jointly by the International Union of Pure and Applied Chemistry (IUPAC) and the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), and endorsed by many other scientific and health care organisations, for all types of properties measured or examined in the clinical laboratory (2,3). This syntax is intended as a mean to improve the communication worldwide on semen determinations, both measurements and examinations.

The IUPAC-IFCC systematic syntax of any property requires the description of: (i) the biological system under study [e.g.: semen], (ii) the system component taken into account [e.g.: Spermatozoa], and (iii) the kind-of-property [e.g.: number (of Spermatozoa) fraction]. When necessary, a specification may be added in parenthesis to any of these elements.

Fixing the order of these three elements —system, component and kind-of-property— according to the internationally recommended syntax, the outcome is a phrase that, in short, describes a generic property as follows:

System(specification)—Component(specification); kind-of-property(specification)

The specific rules to describe the elements of a generic property and the examination result are given in the following points.

RULES TO DESCRIBE THE BIOLOGICAL SYSTEM UNDER STUDY:

1. Full name with initial upper-case letter or the corresponding symbol. Two series of symbols have been recommended for biological systems; one series is for English and other Anglo-Saxon languages, and the other one is for Romance, Latin-derived, languages.

2. Specification in parenthesis following the name or symbol of the system without a space, when necessary. For the type of properties included in this text, usually the specification is the supersystem to which the biological systems under consideration belongs [e.g.: Cells(Sem)].
3. A long dash (—), rather than two hyphens (--), following the system name or symbol, or eventually its parenthetic specification, and without a space, separating system from component.

RULES TO DESCRIBE THE COMPONENT:

1. No space before the component separating it from system or its specification.
2. Unabbreviated systematic or trivial recommended name with initial upper-case letter. Names used for components are the official names recommended by the international scientific organisations. Abbreviations are to be avoided, also when the system is given by code.
3. Names of two separate entities entering into numerator and denominator respectively of a ratio between two quantities of the same system and having the same kind-of-property, both names with initial upper-case letter and separated by a slash with no space before or after.
4. Specification in parenthesis following the name without space. Elements of specification separated by semicolon and space.
5. A semicolon following component name or specification parenthesis, and without a space, separating component and its specification from kind-of-property.

RULES TO DESCRIBE THE KIND-OF-PROPERTY:

1. A space before the kind-of-property separating it from the semicolon that follows component.
2. Full name with initial lower-case letter or an abbreviation. There is a list of recommended names and abbreviations in many languages.
3. Specification in parenthesis following the name or abbreviation without a space. Elements of specification in full, in abbreviated or coded form, separated by semicolon and space. Names of kinds-of-property may be supplemented with specifications necessary to avoid misunderstandings. The specifications are related to the measurement procedure, including previous events, time-related information, calibration, and notes on the analytical procedure.

RULES TO DESCRIBE THE RESULT:

1. One or more spaces before the relational operator separating it from the kind-of-property.
2. When the relational operator is the symbol of 'equal to' (=) and there are many spaces separating it from the kind-of-property, this relational operator may be omitted.
3. One space before the result separating it from the relational operator.
4. The examination result.

In Table 1 the description of properties related to human semen examination according to the WHO “Laboratory manual for the Examination and processing of human semen” (1) are shown.

Most of the properties have already been defined by IUPAC-IFCC (4), so they have NPU code; but some others have been systematically described for first time in this article. In the table these properties are the ones without NPU code.

When the symbol * appears means that the description is an alternative description proposed in this article for the property just above described.

References

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3. International Union of Pure and Applied Chemistry, International Federation of Clinical Chemistry. Compendium of terminology and nomenclature of properties in clinical laboratory sciences. (The Silver Book). Oxford: Blackwell; 1995.
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| Table 1 | |
|---|---|
| Description of the properties related to human semen examination | |
| Properties related with collection of semen | |
| NPU03411 | Pt—Sexual abstinence; time = |
| NPU03410 | Sem—Duration after ejaculation; time = |
| * | Sem—Sample delivering; time = |
| | Pt—Semen collection; location({home; clinical laboratory}) = |
| Properties related with the initial macroscopic examination | |
| NPU03409 | Sem—Liquefaction; time(37 oC; WHO 2010; {≤ 60 min; > 60 min}) = |
| | Pt—Semen(ejaculate); wholeness(WHO 2010;{0; 1}) = |
| NPU03992 | Pt—Semen; colour (WHO 2010; {grey-opalescent; red-brown; yellow}) = |
| NPU03407 | Pt—Semen; clarity(proc.; {transparent; opaque}) = |
| NPU03408 | Pt—Semen; arb.viscosity(WHO 2010) = |
| NPU03412 | Pt—Semen; vol.(WHO 2010) = |
| NPU02414 | Pt—Seminal plasma; pH(WHO 2010) = |
| Properties related with the initial (phase-contrast) microscopic examination | |
| NPU03457 | Sperm—Spermatozoa(agglutinated); num.fr.(WHO 2010) = |
| | Sperm—Spermatozoa(head-to-head aggl.); arb.num.(proc.;{1, 2, 3, 4}) = |
| | Sperm—Spermatozoa(tail-to-tail aggl.); arb.num.(proc.;{1, 2, 3, 4}) = |
| | Sperm—Spermatozoa(tail-tip-to-tail-tip aggl.); arb.num.(proc.;{1, 2, 3, 4}) = |
| | Sperm—Spermatozoa(mixed aggl.); arb.num.(proc.;{1, 2, 3, 4}) = |
| | Sperm—Spermatozoa(tangle aggl.); arb.num.(proc.;{1, 2, 3, 4}) = |
| NPU03462 | Sperm—Spermatozoa motility; num.fr.(list; proc.) |
| | Sperm—Spermatozoa(progressive motility); num.fr.(WHO 2010) = |
| NPU08728 | Sperm—Spermatozoa(non-progressive motility); num.fr.(WHO 2010) = |
| NPU08729 | Sperm—Spermatozoa(immotile); num.fr.(WHO 2010) = |
| NPU08748 | Sperm—Spermatozoa(motile with IgA); num.fr.(IBT; proc.) = |
| NPU03460 | Sperm—Spermatozoa(motile with IgA); num.fr.(MAR; proc.) = |
| NPU08749 | Sperm—Spermatozoa(motile with IgG); num.fr.(IBT; proc.) = |
| NPU03461 | Sperm—Spermatozoa(motile with IgG); num.fr.(MAR; proc.) = |
| NPU08750 | Sperm—Spermatozoa(motile with IgM); num.fr.(IBT; proc.) = |
| NPU08725 | Sperm—Spermatozoa(motile with IgM); num.fr.(MAR; proc.) = |
| NPU18195 | Sem—Spermatozoa; motility(3 h; proc.) = |
| NPU18194 | Sem—Spermatozoa; motility(proc.) = |
| NPU03997 | Sem—Spermatozoa; vel.(curvilinear) = |
| NPU03453 | Sem—Spermatozoa rotation; frequency = |
| Properties related with the spermatozoa vitality | |
| NPU03459 | Sperm—Spermatozoa(live); num.fr.(WHO 2010) = |
| Properties related with the spermatozoa concentration in semen | |
| NPU03455 | Sem—Spermatozoa; num.c. = |
| NPU14374 | Sem—Spermatozoa; arb.c.(proc.) = |
| NPU18891 | Sem—Spermatozoa; arb.num.(proc.) = |
| NPU18199 | Sem—Spermatozoa; arb.num.c.(proc.) = |
| NPU18843 | Sem—Spermatozoa; life span(after ejaculation) = |
| NPU03454 | Sem—Spermatozoa; num.(proc.) = |
| Properties related with the microscopic examination of stained smears | |
| NPU03456 | Sperm—Spermatozoa; morphology(list; proc.) |
| NPU18887 | Sperm—Spermatozoa; morphology(proc.) = |
| NPU08574 | Sperm—Spermatozoa(normal); num.fr. = |
| NPU08722 | Sperm—Head(amorph); num.fr. = |
| NPU08579 | Sperm—Head(duplicate); num.fr. = |
| NPU08575 | Sperm—Head(large oval); num.fr. = |
| NPU08581 | Sperm—Head(pin); num.fr. = |
| NPU08578 | Sperm—Head(pyriiform); num.fr. = |
| NPU08580 | Sperm—Head(round); num.fr. = |
| NPU08576 | Sperm—Head(small oval); num.fr. = |
| NPU08577 | Sperm—Head(tapering); num.fr. = |
| NPU08723 | Sperm—Head(vacuolated); num.fr. = |
| NPU08583 | Sperm—Midpiece(abnormal); num.fr. = |
| NPU08587 | Sperm—Tail(coiled); num.fr. = |
| NPU08588 | Sperm—Tail(duplicate); num.fr. = |
| NPU08963 | Sperm—Tail(norm.); num.fr. = |
| NPU08724 | Sperm—Tail(swollen); num.fr. = |
| NPU08584 | Sperm—Cytoplasmic droplet; num.fr. = |
| | Sperm—Excess residual cytoplasm; num.fr. = |

Table 1

Description of the properties related to human semen examination

Properties related with the microscopic examination of cells other than mature spermatozoa in semen

| | |
|----------|---|
| NPU01520 | Sem—Cells other than spermatozoa; num.c.(list; proc.) |
| | Sem—CD45+ cells; num.c.(WHO 2010) |
| | Sperm—CD45+ cells;num.fr.(WHO 2010) |
| | Cells(Sem)—Peroxidase;arb.cont.(WHO 2010) |
| | Sperm—CD45+ cells;num.fr.(WHO 2010) |
| NPU20193 | Sem—Epithelial cells+ immature germ cells+leukocytes; num.c.(WHO 2010) = |
| | Spem—Epithelial cells+ immature germ cells+leukocytes); num.fr.(WHO 2010) = |
| NPU08718 | Sem—Germ cells+leukocytes; num.c.(WHO 2010) = |
| | Sperm—Germ cells+leukocytes; num.fr.(WHO 2010) = |
| | Sem—Isolate heads; num.c. = |
| | Sem—Isolate tails; num.c. = |
| NPU03448 | Sem—Spermatic cell type; num.c.(list; proc.) |
| NPU03443 | Sem—Spermatids(sab); num.c. = |
| NPU03444 | Sem—Spermatids(scb); num.c. = |
| NPU03449 | Sem—Spermatocytes(primary); num.c. = |
| NPU03450 | Sem—Spermatocytes(secondary); num.c. = |
| NPU03451 | Sem—Spermatogonia; num.c. = |

Immunological properties related with spermatozoa

| | |
|----------|---|
| NPU03447 | SemP—Spermatozoal antibody; arb.c.(IBT; proc.) = |
| NPU08962 | SemP—Spermatozoal antibody; arb.c.(MAR; proc.) = |
| NPU03445 | CerMu—Spermatozoal antibody; arb.c.(proc.) = |
| NPU03446 | P(B)—Spermatozoal antibody; arb.c.(proc.) = |
| NPU26759 | P(B)—Spermatozoal antibody; arb.subst.c.(proc.) = |

Biochemical properties related with seminal plasma

| | |
|----------|---|
| NPU02097 | SemP—Fructose; subst.c. = |
| NPU02215 | SemP—Glucan 1,3- α -glucosidase; cat.c.(37 °C; WHO 2010) = |
| NPU16940 | SemP—Zinc(II); subst.c. = |
| NPU01067 | SemP—Acid phosphatase, prostatic type; cat.c.(37 °C; WHO 2010) = |
| NPU01484 | SemP—L-Carnitine; subst.c. = |
| NPU01593 | SemP—Citrate; subst.c. = |
| NPU08720 | SemP—Glycerophosphocholine; subst.c. = |

Indices of multiple sperm defects

| | | |
|----------|---|----------|
| NPU08574 | Sperm—Spermatozoa(normal); num.fr. = | <i>a</i> |
| NPU08574 | Sperm—Spermatozoa(abnormal); num.fr. = | <i>b</i> |
| NPU08721 | Sperm—Head(abnormal); num.fr. = | <i>c</i> |
| NPU08583 | Sperm—Tail(midpiece abnormal); num.fr. = | <i>d</i> |
| | Sperm—Tail(principal piece abnormal); num.fr. = | <i>e</i> |
| | Sperm—Excess residual cytoplasm; num.fr. = | <i>f</i> |

| | |
|----------------------------------|---------------------------|
| Multiple anomalies index (MAI) = | $(c + d + e)/b$ |
| Teratozoospermia index (TZI) = | $(c + d + e + f)/b$ |
| Sperm deformity index (SDI) = | $(c + d + e + f)/(a + b)$ |

Properties related with the interaction between spermatozoa and cervical mucus

| | |
|----------|---|
| NPU08752 | Sem(Pt ID)+CerMu(Pt ID)—Spermatozoal penetration; k-o-p(Kremer; proc.) = |
| NPU03458 | Sem(Pt ID)+CerMu(Pt ID)—Spermatozoal penetration; k-o-p(post-coital; proc.) = |
| NPU08751 | Sem(Pt ID)+CerMu(Pt ID)—Spermatozoal penetration; k-o-p(SCMC; proc.) = |

Microbiological properties related with semen

| | |
|----------|--|
| NPU06124 | Sem—Bacterium(ag); taxon(proc.) = |
| NPU06724 | Sem—Bacterium(ag; spec.); arb.c.(proc.) = |
| NPU06174 | Sem—Bacterium(DNA); taxon(proc.) = |
| NPU06774 | Sem—Bacterium(DNA; spec.); arb.c.(proc.) = |
| NPU06574 | Sem—Bacterium(RNA); taxon(proc.) = |
| NPU07174 | Sem—Bacterium(RNA; spec.); arb.c.(proc.) = |
| NPU17947 | Sem—Bacterium(spec.); suscept.(list; MBC; proc.) = |
| NPU17913 | Sem—Bacterium(spec.); suscept.(list; MIC; proc.) = |
| NPU13748 | Sem—Bacterium(spec.); suscept.(list; ord.sc.; proc.) = |
| NPU07277 | Sem—Bacterium(spec.); suscept.(list; rat.sc.; proc.) = |
| NPU06677 | Sem—Bacterium; arb.c.(proc.) = |
| NPU06077 | Sem—Bacterium; taxon(proc.) = |
| NPU18710 | Sem—Bacterium+fungus; taxon = |
| NPU06274 | Sem—Fungus(ag); taxon(proc.) = ? |
| NPU06874 | Sem—Fungus(ag; spec.); arb.c.(proc.) = |
| NPU06324 | Sem—Fungus(DNA); taxon(proc.) = |
| NPU06924 | Sem—Fungus(DNA; spec.); arb.c.(proc.) = |
| NPU06624 | Sem—Fungus(RNA); taxon(proc.) = |
| NPU07224 | Sem—Fungus(RNA; spec.); arb.c.(proc.) = |
| NPU06824 | Sem—Fungus(spec.); arb.c.(proc.) = |
| NPU07324 | Sem—Fungus(spec.); suscept.(list; ord.sc.; proc.) = |
| NPU13830 | Sem—Fungus(spec.); suscept.(list; rat.sc.; proc.) = |
| NPU06224 | Sem—Fungus; taxon.(proc.) = |
| NPU06424 | Sem—Virus(ag); taxon.(proc.) = |
| NPU07024 | Sem—Virus(ag; spec.); arb.c.(proc.) = |