5 Steps to writing your Materials and Methods section

The material and methods (or sometimes “Methods”) section is where you explain how you conducted your investigation. It is a chronological description of precisely how the study and the experiments involved were performed and conducted.

Care must be taken in writing the methods section since it is an indication regarding the validity of the research work. It must be written with such clarity and detail that a reader could reproduce the study themselves. The requirements of the target journal should be checked at the start since they may vary.

This article gives some helpful information about writing the methods section for a scientific paper:

Content of a methods section

Split into 2 sections		Content of each section	
A	**MATERIALS**	**What**:	
		• The sample or material, e.g. chemical, tissue, organism ...	State the source, supplier and preparation of sample/material
		• The intervention, e.g. drug, device, dilution ...	Give the detail - e.g. drug generic name, brand and manufacturer, the solution or device/technique and any modifications
		• The instrumentation, e.g. the balance, the freeze-drier, the spectrometer, etc.	The equipment: model, manufacturer, address and calibration
B	**METHODS**	**How**	
		• Describe the experimental design	What was done, in what order? Explain measurement techniques? State variables, number of samples, controls … Quantify readings use appropriate metric units. What stats did you use?
		• Describe the data analysis	How was your experimental data analysed? Means, standeard errors, coefficients of variation, etc.
		Who, **when and where?**	Who conducted the experiments, when (if relevant) and where did it take place?
		Why	Reason for choosing the procedure/process/technique …
		Ethics	Describe ethical considerations and procedures, where relevant.

You may find it helpful to read the following paper:

"How to write a scientific paper— - writing the methods section"
http://www.elsevier.pt/en/revistas/revista-portuguesa-pneumologia-320/artigo/how-write-scientific-paper-writing-methods-section-S0873215911000973/

A good (Materials and) Methods section:

- Is clearly laid out and ordered in sections and sub-sections – using appropriate sub-headings – to help the reader navigate and follow
- Is a brief, precise and yet detailed account of what you did
- Uses the third person (past tense), e.g. "*the sample was tested using ...,"* and not, "*I tested the sample using ...*"
- Is ordered chronologically
- Is written in paragraphs, not as a series of steps
- States the reasons behind the choice of methods
- Clearly describes processes and techniques
- Indicates the source of materials (not batch numbers – these go in your Project Notebook only)
- Gives details of the equipment and facilties used, including the make, model and manufacturer
- Describes data collection techniques and variables
- Describes data manipulations and calculations
- Include references to statistical significance, where required
- Describes ethical considerations (if relevant)

It does NOT:

- Include any results
- Give background information or explain reasons for the study
- Include any irrelevant information or superfluous detail
- Sound like a set of instructions

Look at the methods extract that follows. Note and highlight:

Extract from: Int J Pharm. 15 June 2016, 506 (1-2): 102-109

		✓
The use of subsections	Descriptive and also perhaps numbered, as here i.e. 2.2, 2.2.1 …	
The source of the materials	See where it says *"were purchased from.." "were supplied by .." "obtained from .."* etc. and then the company name	
Description of a technique and the purpose of using it	E.g. the technique used to analyze the nanoemulsion size distribution	
Equipment details	Make and model details, manufacturer and location	
Calculations and data manipulation	E.g. the loading efficiency of paclitaxel	
Statistical significance explanation	What statistical analyses were carried out and what criteria have you used to consider a result statistically significant?	

2. Materials and methods

2.1. Materials

Dextran (MW 5000), dimethyl sulfoxide (DMSO), Phosphate buffered saline (PBS), poly-l-lysine (PL; MW 70,000), sodium pyruvate and trypan blue were all purchased from Sigma Aldrich, UK. Trypsin-EDTA (Ethylenediaminetetraacetic acid) solution, absolute ethanol, 70% ethanol and HPLC-grade water were supplied by Fisher Scientific, UK. Eagle's minimum essential media (EMEM), non-essential amino acid solution (100x) and L-glutamine (2 mM) were purchased from Lonza, Switzerland. The anticancer drug paclitaxel was obtained from Sigma Aldrich, UK and the parenteral nutrition emulsions, Clinoleic 20% and Intralipid 20% were supplied by Baxter Healthcare, USA and Fresenius Kabi, Germany respectively. The U87-MG (grade IV glioma cell lines) and SVG-P12 (normal glial cell lines) were supplied by the European Collection of Cell Cultures (ECACC).

2.2. Methods

2.2.1. Solubilization of paclitaxel in PN nanoemulsions

Paclitaxel was weighed in amounts of 0 (blank), 10, 20, 30, 40, 50 and 60 mg in separate glass vials. 10 ml of Clinoleic or Intralipid emulsions were added to each glass vial followed by vortex-mixing for 5 min and bath sonication for 2 h at 40 °C. Preliminary results showed that there was no effect of bath sonication on the stability of emulsions (data not shown).

2.2.2. Particle size and zeta potential analysis of nanoemulsions

Photon correlation spectroscopy (dynamic light scattering) was used to analyse the size distribution of nanoemulsions by employing the Zetasizer Nanoseries instrument (Malvern Instruments Ltd, UK). Clinoleic or Intralipid nanoemulsions (40 μl) (without any filtration) were diluted with 1 ml HPLC-grade water in a clean Malvern sample vial, and the hydrodynamic diameter and polydispersity index (PI) of the emulsion droplets were measured. The same instrument was employed to analyse the zeta potential of the emulsions, by laser Doppler velocimetry, by operating the relevant software. The zeta potential cuvette (Malvern Instruments Ltd, UK) was washed several times with HPLC water prior to loading the nanoemulsion samples and measuring the zeta potential values of the different formulations.

2.2.3. pH determination of nanoemulsions

The pH of emulsion formulations was determined using a Corning 220 pH meter (Cole-Palmer, Teddington, UK) previously calibrated using the provided pH 4 and pH 7 solutions. This experiment aimed to investigate the influence of nanoemulsion type and paclitaxel concentration on the pH, and compare the values with those of blood plasma.

2.2.4. Loading efficiency of paclitaxel in nanoemulsion droplets

Entrapment efficiency of paclitaxel was determined by adapting the separation methods previously described by Kumar et al. (2001) and Gala et al. (2015). The nanoemulsion formulations containing paclitaxel (10, 30 and 60 mg per 10 ml) were filtered through a 0.4 μm pore-size syringe filter (Fisher Scientific, UK). The filter was washed with HPLC water until the solution ran clear. The filter was then placed in absolute ethanol and paclitaxel was extracted. The extracted fraction was collected to determine the proportion of un-entrapped drug by measuring the absorbance in ethanol at 227 nm using a UV spectrophotometer (Jenway 7315 Spectrophotometer, UK). This amount was subtracted from the total amount of paclitaxel in the formulation to calculate the amount of entrapped drug. The solubility of paclitaxel in water is less than 0.1 μg/ml (Konno et al., 2003), therefore, the amount of the drug dissolved in water during hydration was negligible. The loading efficiency (LE) of paclitaxel (PX) in nanoemulsion was calculated using the following equation:

View the MathML sourceEE(%)=Amount of PX entrappedTotal amount of PX in nanoemulsion formulation×100

2.2.5. Statistical analysis

All experiments were performed three times using three different batches and the results are presented as the mean ± SD. The student's t-tests and one-way ANOVA tests were performed using SPSS 14.0 software to calculate the significance between the groups. The differences were considered to be statistically significant if the P-value was less than or equal to 0.05.

Use the guidance on the following page to develop your own Methods section

	5 steps to develop your Method section	
		✓
STEP **1**	**LIST** • the materials you used and their source • the equipment you used, including make, model, manufacturer, country sourced	
STEP **2**	**DESCRIBE METHODS** • all the experimental techniques you used • why these techniques were employed/chosen and who by, when and where (if relevant) • ethical considerations and procedures (if relevant)	
STEP **3**	**DESCRIBE DATA COLLECTION** • procedures and variables and controls • analysis techniques, manipulations and calculations • stats. and statistical relevance	
STEP **4**	**Bring STEPs 1 – 3 together** • Order your description of the techniques and analysis chronologically • Order with sub-headings to make it easy for the reader to follow • Take care with your writing style – use plain English in the third person, clear and concise	
STEP **5**	**CHECK AND EDIT** • Ask a colleague to read, could they reproduce the work from your description?	