Handbook of Perfumes and Flavors

By

Dr. Olindo Secondini

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To my wife, Ann Katya

The Author

Dr. Olindo Secondini has worked in the fields of Essential Oils, Flavors, Perfumes, Cosmetics, Toiletries, and Aromatic Chemicals in the United States, Europe, Latin America, Africa, and the Middle East. He has also taught Chemistry and Chemical Engineering at several universities.

Dr. Secondini has published in various languages, particularly in Spanish with the leading newspaper "El Imparcial" of Guatemala, Central America, where he worked on research and development of natural resources.

He is a Fellow of the American Institute of Chemists.

First Foreword

By Paul B. Slawter, Jr. FAIC
Former Executive Secretary, The American Institute of Chemists
Former Editor, The Chemist

Some years ago, Dr. Olindo Secondini brought me a manuscript to consider for a publication of which I was an editor, "The Chemist," official organ of The American Institute of Chemists. Dr. Secondini was an experienced chemist in the field of essential oils, flavors, perfumes, cosmetics, toiletries, and aromatic chemicals.

I was fascinated by his story and published it in the next issue. It had a somewhat whimsical title, "Is our Sense of Scent Lost?"

The article must have made a lot of sense because we had more editorial reaction to it than to any article I had published in 60 issues over a five-year span. Dr. David W. Young, a noted American scientist, then President of the AIC, said it was the best he had ever read on this interesting subject. Several essential oil companies ordered extra copies for distribution.

Recently, Dr. Secondini brought me another manuscript, this time a formidable tome on flavors and perfumes. I must say: *This is the best* I have ever read on these interesting subjects. Dr. Secondini is to be congratulated by the likes of me and thanked by the likes of people in the business of essential oils and related materials for providing what has to be the last word on the compounding of flavors and perfumes. His entire book should be subtitled "The Gamut of Flavors and Perfumes from A to Z."

As one peruses this volume, from the history of perfumes and cosmetics to the constituents of the essential oils so important to the industry, one gets the feeling that everything, which means anything to a flavorist or a perfumer, is here for the reading.

Today, there is increased interest and awareness on the part of the general public in flavors and perfumes, which, like food and clothing, are growth industries with unlimited futures. Dr. Secondini shows how the level of production is now sufficiently large to make flavors and perfumes a most important factor in American economy and resource planning.

Its 474 pages make the publication more than a handbook for practical formulation of flavors and perfumes. It is truly a workbook of inestimable value for an industry with no place to go but upward.

Second Foreword

By Donald A. Davis
Editor, Drug & Cosmetic Industry (magazine)

There haven't been nearly enough additions to the sparse body of technical books about perfuming and flavor materials over the past two decades, though the technological advances in this area have been remarkable. In fact, it was almost as though the late Steffen Arctander had a monopoly on the subject during his long and productive lifetime. That said, it is good to have this contribution from Dr. Olindo Secondini, who has had a varied career in academia, in industry, and even in medicine.

This is far more than a simple handbook for perfumer or chemist or research worker in the field. Besides giving a comprehensive outline of each essential oil, aromatic, flavor, and fixative, it breaks down the physical and chemical character of natural materials. What is more, it provides valuable clues for the compounding or manufacture of a wide range of synthetic versions of those increasingly scarce, sometimes unbelievably expensive derivatives from rare animals or plants that grow only in remote jungles or savannahs. There is little chaff here, Dr. Secondini staying throughout with what he originally set out to do. The prediction from this quarter is that this will become a standard reference work, and remain one for years until someone equally ambitious undertakes to do another 30 or 40 years hence. One interesting addition not usually seen in such a book is a small section suggesting new kinds of perfumes, some oriented toward fragrances far different than are encountered in any now on the market. Such targets of opportunity seem worthy of attention by some innovative compounder—and reflect well on the author's imagination.

Third Foreword

By David W. Young, Sc.D., P.E.
Vice President, Young & Kather Associates, Inc.
Member of Board of Directors, ACC&CE

This book is based on a fresh approach to the analysis and interpretation of odor evaluation tests. Utilizing his years of experience, observation, and personal judgment, the author presents new insights and attitudes regarding the nature and method of odor evaluation testing. Dr. Secondini published a similar article in "The Chemist," the official publication of the AIC.

This book is strictly practical while at the same time provides indispensable technical and scientific details. The book presents important information for all. The chemist will require this work as well as the student of chemistry. It is a fresh theme in the area of industrial chemistry.

I strongly recommend this book to anyone involved in the application of odors for commercial use.

Fourth Foreword

By Annette Green, Executive Director, The Fragrance Foundation

In the last twenty-five years, the universe of olfaction has expanded beyond anyone's imagination and the pleasures of fragrance, in particular, have captured the minds and hearts of people in every culture, every environment, every social level.

As we enter an even more highly developed technological decade, it becomes increasingly clear that many of the challenges we will all face will call on a completely new mindset in interpreting sensory needs and providing a vast range of experiences which will be resolved through sensory experiences.

It has never been more imperative to provide scientists, students, perfumers, and scholars with the most effective and authoritative tools. They must not only provide the broadest possible perspectives of the extremely complex field of fragrance creation (historically, culturally, scientifically), but also create an environment for higher consciousness and creativity.

I believe Dr. Secondini has accomplished this monumental feat in his extraordinary work which is represented in this volume. I salute him and thank him for his masterful contribution to the world of fragrance and the sensory lives of societies of the future.

Preface

In line with the human necessities, flavors and perfumes, like the food and clothing industries, are omnipresent and fast growing.

The correlated literature, however, although necessary for bringing up-to-date information for research and development, is comparatively slow and rather scarce. Even educational institutions are still not interested in giving courses in this important field of daily consumption comprehending biological, botanical, and chemical sciences.

This book provides a general orientation to the subject and information on the compounding of basic flavors for food and floral perfumes for personal use, for cosmetics, soaps, disinfectants, deodorants, and antipollutants. All are concisely described in the 995 formulas of perfumes and flavors and the related material reported in this book.

Regardless of scientific and technical education, or experience in this field, this book can contribute to the necessary knowledge for the compounding of any flavor or perfume. However, since the perception of taste and odor is intrinsically individual, a creative technique is indispensable for improving and expanding on this very fascinating industrial activity.

The author, who has many years of practical experience in this field, gratefully acknowledges and thanks the authors of the very valuable books listed in the bibliography, which have amply helped in the compilation of this book.

Olindo Secondini

Explanatory Notes

1. CLASSIFICATION OF FORMULAS

The formulas, as reported in this book, are classified in four categories:

1. ***Essences:*** Compounds made with natural products, such as Essential Oils, Balsams, Resinoids
2. ***Extracts:*** Made from barks, roots, leaves, seeds, buds, fruits, flowers, in their natural state.
3. ***Imitation:*** A mixture of essences, extracts, and esters in prevalence.
4. ***Synthetics:*** A duplication of the natural product, made generally with a combination of esters. Esters are fragrant compounds formed by the reaction between an acid and an alcohol. For example, ethyl acetate is made by heating acetic acid and ethyl alcohol in the presence of sulfuric acid and distilling. The synthetic formula, when there is more than one of the same species, has a progressive number.

2. COMPOSITION

All the formulas are of a general orientative nature. It remains exclusively to the compounder to improve each one, either reducing, increasing, or modifying the components in each formula, in accordance with his taste and olfactory stimulus. Good flavors, or perfumes, are not derived from the best formulas. The success, in compounding the ingredients (which must be excellent in taste and odor) depends on the sense of taste and scent of the compounder.

3. TURBIDITY

The ingredients must be blended thoroughly and totally clear in an absolute pure and odorless solvent such as ethyl alcohol 95% from grain, propylene glycol, neutral glycerin, distilled water, and other solvents. Many of the formulas will probably give turbidity in their compounding. This can be eliminated, or at least reduced, by increasing the amount of solvent, or by repeated filtration.

4. UNSPECIFIED UNITS FOR WEIGHTS, VOLUMES, OR PERCENTAGES

The unit measures in the manufacture of synthetic aromatic basic material, or formulas

for flavors and perfumes, could either be in kilograms, if the material is solid, or liters, if the material is liquid.

The amount of *1000*, for instance, with unspecified unit, could be either 1000 kilograms or 1000 grams (1 kilogram); or 1000 liters or 1000 milliliters (1 liter).

As standard practice in the use of all components no units are specified. The same chosen unit must be applied to all items in the required material or formulas.

Example:

1.	Distilled Water	1000
2.	Ethyl Alcohol	1000
3.	Sugar	500

In this case, because the units are unspecified, all components are measured by weight, which will be either in kilograms or grams. The formula must therefore be understood as:

1.	Distilled Water	1000 grams
2.	Ethyl Alcohol	1000 grams
3.	Sugar	500 grams

The unspecified units facilitate any system of measure, particularly those of foreign countries. Therefore, the unspecified amount could be: kilograms, grams, liters, milliliters, ounces, etc.

In this book all unspecified amounts must be understood as *parts by weight.*

5. USES OF THE FORMULAS FOR ESSENCES

The amount of any formulas, to be basically employed in making essences, is in the proportion of 2 or 3 parts (2 or 3 grams × 1 kilogram (1000 grams) of solvent).

6. CONCRETE, ABSOLUTE, RESINOID

Concrete—a waxy solid obtained from roses by extraction without solvents, or after removing the solvent; the essential oil. Absolute—free from admixture with other substances, e.g., absolute alcohol which is dehydrated as ethyl alcohol 99% pure. Resinoid—any thermosetting synthetic natural, vegetable-derived resin. The best known are rosin and balsam from coniferous trees. Their use is in varnishes and adhesives.

7. TINCTURES

Tincture—an alcoholic or aqueous-alcoholic solution of vegetable material.

All tinctures are made by maceration, stirring every day for one hour, until total dissolution is obtained in flavor and odor (approximately one week) and filtering at the end until completely clear.

8. UNSPECIFIED NATURAL PRODUCTS (OIL OR CONCRETE)

When a natural product, such as carnation, gardenia, etc. is not specified, either as an oil or concrete, it refers to its imitation or synthetic formula reported in the book.

9. COLORS

In coloring flavors or perfumes, only certified colors or the natural, legally exempted from certification colors must be used. The color must be added before filtration, which is necessary even if the product appears clear.

10. TEMPERATURE

The temperature is in Centigrade (°C), with the exception of flash point TCC (Tagliabue Closed Cup) given in Fahrenheit (°F). Specific gravity is given at 25/25°C. Refractive index and optical rotation are at 20°C. Different temperatures are specified in parenthesis.

11. SOLUBILITY

Number refers to the amount of alcohol, or other solvent, needed to dissolve the material. Example 2/70% means two volumes of alcohol at 70%; 3/80% means three volumes of alcohol at 80%; 2–8/70% means that the volume of alcohol may be from two to eight volumes at 70%.

12. FORM OF THE MATERIAL

If it is not liquid, a specification is given either as a powder, crystals, etc.

13. HABITAT

When the habitat is not specified, worldwide existence is assumed.

14. SOLUTION

When not specified, the solvent for solutions is ethyl alcohol 95%.

15. NATURAL PRODUCTS

For natural products, when particular parts, e.g., oil, concrete, bark, flowers, leaves, resinoid, roots, tops are not specified, they must be used in their total natural state.

16. CAS NUMBERS

Whereever possible, the American Chemical Society's Chemical Abstract Service (CAS) registry numbers have been included to facilitate accurate identification of a given chemical substance.

17. ABBREVIATIONS

C ..... degrees Centigrade
cc ..... cubic centimeter
CC ..... closed cup
cl ..... centiliter
cml ..... centimilliliter
EDTA ..... ethylene diamine tetraacetate
F ..... degrees Fahrenheit
FDA ..... Food and Drug Administration
g ..... gram
gal ..... gallon
h ..... hour
kg ..... kilogram
l ..... liter
max ..... maximum
min ..... minimum, minutes
ml ..... milliliter
OC ..... open cup
sol'n. ..... solution
TCC ..... Tagliabue Closed Cup
> ..... greater than

NOTICE

Neither the author nor the publisher assumes any liability with reference to the use, applications, or for damages resulting from the use, any information, apparatus, methods, or processes described in this book.

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Chapter I:

ODORS

Introduction

"The Rose distills a healing balm
The beating pulse of pain to calm"
—Alexander Farkas

From early Spring to late Fall, scent is all around us, particularly in the Southern states, where plants are more extensively flowering and where Spring starts earlier and Fall lasts longer. The color of all these flowers, in their beautiful multivariety, is overwhelming. But very few people will probably pay any attention to their odors.

Paradoxically, even though odors—currently called perfumes—are extensively used by almost everyone, either applying them directly to the body, or indirectly through the use of soaps, creams, powders, detergents, etc., the human sense of smell has degenerated during the last centuries, and is in danger of being lost.

The impact of pollution has already had a deleterious effect, beginning during the Industrial Revolution when people started to desert farms and countryside in order to find work in the growing factories and continuing through this century with the evolution of mechanical transportation. Our cities are now filthy with smoke of factories and exhaust from cars. Parks and countrysides smell of pesticides and chemical fertilizers. Highways offend our sight and nose with the bodies of innocent animals killed by our crushing transportation.

The first men who populated our planet certainly had a better sense of smell, as wild animals still have. Early man had to use primarily smell and taste in order to investigate what kind of food he could use for his nourishment. Forced to select organic materials which could be poisonous, putrefied, and so forth, the nose was the master guide with the sense of taste as supervisor.

Until the beginning of this century, flowers and herbs were still collected for their scent and aroma, and preserved in order to be used during the nonflowering seasons. Cities had herbal shops for this purpose, and druggists and pharmacists stored them in their laboratories. Since the beginning of civilization men of science and lovers of nature have attempted to distinguish and classify odors. A fundamental classification of odors is reported throughout history.

EARLY HISTORY OF PERFUMES

Early in the history of humanity it appears that men burned various kinds of woods for warmth and light during the nights and cold winter seasons. Thus, they accidentally discovered the pleasant smell of the smoke that drifted through the air over the flames from some of the naturally perfumed woods. The French name "parfum" comes from the Latin preposition "per" meaning *through* and the substantive "fumus" meaning *smoke.*

Primitive men also accidentally discovered that putting resinous wood in water made it oily and odorous. Rubbing the body with the resinous material produced a feeling of pleasure by improving their body odor and protecting their skin. The development of perfumes, therefore, can be traced as far back as the beginning of the history of humanity.

Perfumes have been found in the Egyptian pharaohs' tombs. The Ebers' papyrus, which refers to the beginning of recorded history in the Nile Valley, contains formulas in which botanicals, minerals, and animal products were employed. They are still utilized today in the manufacture of perfumes.

Ancient Greeks and Romans learned from the Egyptians. For many centuries perfumes remained an exclusive oriental art. During the period of the Crusades in the early decades of the thirteenth century, perfumes were brought from Palestine to Europe. Trade in spices followed.

In the 1500's perfumes became popular through those made by a certain René, a perfumer from Florence, Italy. René travelled to France with Catherine de Medicis when she went to marry Prince Henry, who later became Henry II of France.

HISTORY OF THE WATER COLOGNE

The perfume which rapidly became the most popular was "Eau de Cologne." The name derives from the fact that the product was initially made in the city of Cologne (Köln), Germany, on the Rhine river, in the early 1700's.

It was first prepared in the town of Cologne by Jean Marie Farina. He was born in Italy in the town of Saint Marie Major, and went to Cologne to trade perfumes. He first prepared this very famous composition in 1709. It is known, however, that the "Eau de Cologne" was first marketed by Paul de Feminis in Milan, Italy, and it was afterwards made in Cologne from 1690. The formula was then passed to his nephew Jan Antoine Farine, who started manufacturing it in Paris in 1806.

The popularity of "Eau de Cologne" since the early 18th century is due to its fresh and clean smell. Many manufacturers in Cologne and elsewhere have continued its trade worldwide. It has perpetuated as a standard type of a lightly refreshing scent. It is a water-alcohol solution of a concentrated citrus essence prevalently extracted from lemon, bergamot, orange flowers, and blended with some lavender and orris roots, with traces of benzoin as a fixative. The finest "Eau de Cologne" is produced by distilling pure ethyl alcohol with the previously mentioned ingredients. Some neroli is further added. The distillate is then left to mature for at least one year.

THE PERFUME INDUSTRY

Alexander Farkas, in the introduction to his book *Perfume Through the Ages,* says:

"The perfume industry is perhaps the most romantic of all industries."

It is indeed true that the perfume industry, even from the chemical point of view, is the most fascinating.

The art of blending natural essences and synthetic odorants to obtain a stable, odoriferous alcohol solution embraces all kinds of organic chemicals, and more extensively than in any other branch of the chemical industry. The psychological influence of a perfume determines its appeal for the customer, and thus its success. Today, all kinds of papers are perfumed to improve their salability. Perfumed merchandise is preferred, and outsells its odorless counterpart by a large margin.

The products of the perfume industry are classified as:

1. Gaseous: Aerosols
2. Liquids: Lotions, Perfumes
3. Pastes: Creams, Toothpastes
4. Solids: Soaps, Powders

THE COSMETICS INDUSTRY

Cosmetics are preparations applied to the surface of the body for the purpose of enhancing its appearance. Cosmetic products aid the whole human body—face, hair, teeth, hands, feet—with the triple purpose of preserving, restoring, or simulating beauty. In a larger sense, cosmetics are products of perfumery. Perfumes of natural origin, such as essential oils, and of synthetic production are usually employed in cosmetics. Cosmetics are liquids, solids, creams, pastes, and powders.

Cosmetics can be generally classified as:

1. Cutaneous cosmetics: Lipsticks, creams, soaps, toilet water
2. Capillary cosmetics: Brilliantines, shampoos, depilatories
3. Dental cosmetics: Toothpastes, liquids, powders

In accordance with their specific properties and intended application, cosmetics may be classified in various categories:

1. Creams
2. Lotions
3. Eye makeup and other eye preparations
4. Lipsticks and other lip preparations
5. Nail preparations
6. Face and body makeup
7. Perfumes and scented preparations
8. Bath preparations
9. Skin cleanser and other skin preparations

10. Shampoo and hair rinses
11. Hair preparations
12. Depilatories
13. Shaving preparations
14. Deodorants and antiperspirants
15. Suntan preparations
16. Miscellaneous: rubbing alcohols, mouthwashes, toothpastes, tooth powders, denture cleaners, face and body powders.

Historical Classification of Odors

CLASSIFICATION OF ARISTOTLE (384–322 B.C.)

The Greek philosopher Aristotle, the greatest influential thinker of Western culture, was the first to classify odors.

He classified odors in six groups in accordance with the sensations:

1. Sweet odors
2. Acid odors
3. Severe odors
4. Fatty odors
5. Sour odors
6. Fetid odors

CLASSIFICATION OF LINNAEOUS (1707–1778)

Linnaeous, the celebrated Swedish botanist, based his odor classification on seven groups:

1. Aromatic odors: Clove, laurel
2. Fragrant odors: Jasmine, lily
3. Ambrosiac odors: Moss, amber
4. Alliaceous odors: Garlic, asafoetida
5. Fetid odors: Valerian
6. Repulsive odors: Solanaceous
67. Distusting odors: Hellebore

Many others have attempted to classify odors, but very few have achieved a passable classification.

CLASSIFICATION OF FOURCROY (1755–1809)

Antoine Francois Fourcroy, a French chemist and politician, founded the French Museum of Natural Sciences, and with Antoine Laurent Lavoisier and C.I. Bertholett, the

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